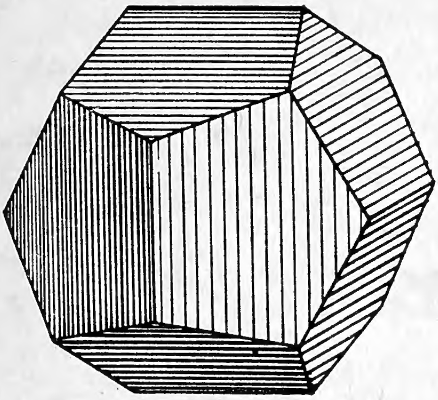

Pyrite Deposits of St. Lawrence and Jefferson Counties, New York

By

John James Prucha
Formerly Senior Geologist
New York State Museum and Science Service

NEW YORK STATE MUSEUM AND SCIENCE SERVICE

BULLETIN NUMBER 357

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COVER ILLUSTRATION: Pyrite crystal (Pyritohedron) illustrating striated faces

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ILLUSTRATIONS

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John James Prucha[1]

Senior Geologist

ABSTRACT

In St. Lawrence and Jefferson Counties, New York, there are 19 known occurrences of pyrite concentration of sufficient magnitude to warrant consideration as possible sources of sulfur. All of the more important deposits occur in a belt about 35 miles long and 3 to 4 miles wide extending northeast from the vicinity of Antwerp. This belt lies within the Grenville Lowlands region of the northwest Adirondacks, southeast of the St. Lawrence River.

The bedrock of the region is principally Precambrian Grenville metasediments and associated granitic rocks, but abundant small outliers of flat-lying Cambrian Potsdam sandstone occur throughout the region. The rocks of the isoclinally folded Grenville series have a marked foliate structure parallel to the northeast regional trend of the lithologic units and major folds and generally dip northwest within the pyrite belt. The Grenville series is 15,000-16,000 feet thick in the Lowlands region.

The earliest pyrite mining in the region was in 1883-84 at the Stella mine. Pyrite mining ceased in 1921. Total production during the period of active mining prior to 1921 was about 600,000 long tons of concentrates, or equivalents, averaging about 40 percent elemental sulfur. The Cole mine and the mines at Stellaville were the principal producers.

Pyrite and lesser amounts of pyrrhotite are essentially the only sulfides present in the ores. A very small amount of secondary hematite is the only metallic oxide found. The deposits occur in rusty-weathering pyritic gneisses. These rusty gneisses are essentially chloritic and graphitic quartz-feldspar-mica gneisses containing more or less disseminated pyrite. The ore veins represent exceptional concentrations of pyrite within the rusty gneisses and occur as thin sheets lying parallel to the foliation of the enclosing rusty gneisses. Analyses of channel samples from 13 deposits indicate a range in sulfur content

[1]Now associated with Shell Development Co., Houston, Texas.

of the ores from 20.2 percent to 35.6 percent. The weighted average of all samples analyzed is 25.6 percent sulfur.

The pyrite of the ores crystallized later than all of the gangue minerals, with the possible exception of sericite, and partially replaces them. Pyrite appears to have replaced chlorite most readily of all the gangue minerals. The graphite content of the ores characteristically parallels increases in the pyrite content.

The pyrite deposits are considered to be concentrations of iron sulfides formed from inherent constituents of the parent sediments from which the rusty gneisses were derived. It is believed that the parent sediments were argillaceous sandstones containing abundant organic impurities and some intercalated calcareous layers. The late-stage formation of abundant chlorite and the evident mobilization and recrystallization of sulfides and graphite well after the period of metamorphism are attributed to the circulation of aqueous solutions.

Further exploration of any of the prospects must be by drilling. The Cole and Stella prospects are considered most promising, largely because of their past history. The Dickson-Wight prospects are the most promising of the undeveloped deposits, followed by the Gold Hill prospect. Exploratory drilling of at least six other prospects might be warranted under favorable economic conditions.

INTRODUCTION

This study of the pyrite deposits of St. Lawrence and Jefferson Counties, New York, was motivated by an acute worldwide shortage of sulfur at the start of the Korean War and the predicted continued disparity between world production and consumption in the next few decades. Shortly after this study began, the immediate sulfur shortage was resolved by new production of brimstone on the Gulf Coast and by the conservation of byproduct sulfur formerly wasted in smelting, oil refining and other industrial processes. Future demands for sulfur, which in the form of sulfuric acid is the very foundation of our industry, will be greatly expanded as world populations increase and agrarian countries become progressively more industrialized. Increased use of commercial fertilizers to increase world food supplies will also necessitate much greater production of sulfuric acid. It is the purpose of this report to describe the nature and occurrence of the pyrite deposits of St. Lawrence and Jefferson Counties and to evaluate them as possible future ores of sulfur.

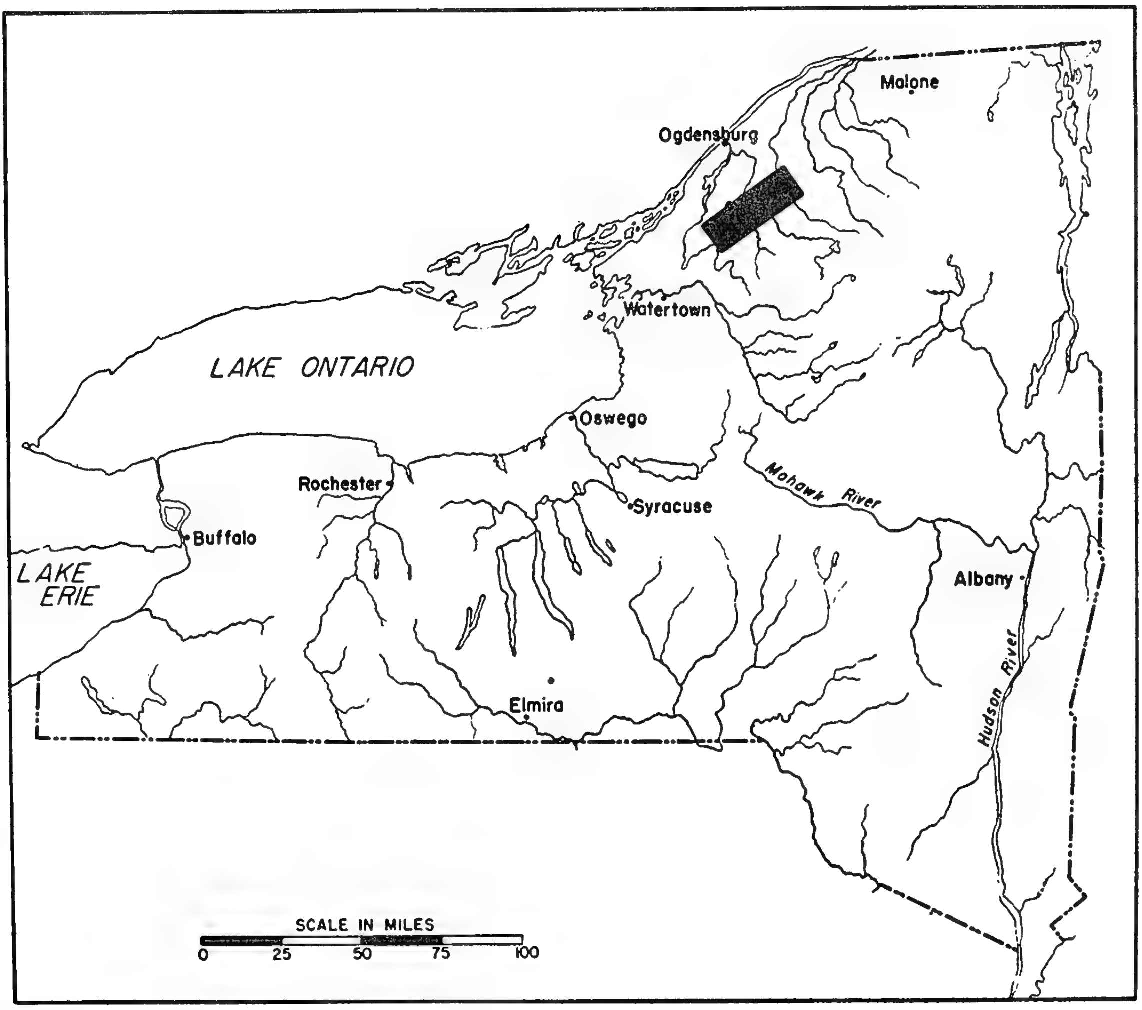


Figure 1. Index map of New York State showing general area of pyrite deposits of St. Lawrence and Jefferson Counties

Location and Accessibility

In St. Lawrence and Jefferson Counties there are 19 known occurrences of pyrite concentration of sufficient magnitude to warrant consideration as possible sources of sulfur. All of the more important deposits occur in an area about 35 miles long and 3 to 4 miles wide extending northeast from the vicinity of Antwerp and including parts of the Hammond, Antwerp, Gouverneur, Canton and Russell quadrangles. This area is served by the New York Central railroad and numerous paved highways. It is only about 25 miles southeast of the St. Lawrence River.

Scope of the Work

Fieldwork for this study began June 10, 1951, and continued with but slight interruption until October 14, 1951. During July and August the writer was assisted in the field by Norman P. Cuppels. Field studies were completed during the last week in June and the months of July and August 1952. In this second field season the writer was assisted by Arthur J. Richards.

Where possible, channel samples were cut on the more promising veins and analyzed for elemental sulfur content. The analyses were run by John A. Graham of the New York State Geological Survey, using a gravimetric method with precipitation of sulfur as barium sulfate (Furman, 1939, pp. 908-9).

Plane table mapping on a scale of 400 feet to the inch was done on the more promising deposits. Reconnaissance mapping was done throughout the entire area in which the pyrite deposits occur.

During the course of the laboratory work 53 thin sections of the ores and associated rocks were studied in detail with the petrographic microscope. About 30 polished sections of the ores were prepared by the writer in the ore laboratory of the Department of Geology, Rutgers University, and studied in the petrography laboratory of the New York State Geological Survey.

Acknowledgments

Diamond drilling data for the Antwerp-Keene belt were made available to the writer by E. F. Fitzhugh, Jr., chief geologist, Republic Steel Corporation.

L. J. Severson, Oliver Iron Mining Division, U. S. Steel Corporation, provided and permitted use of considerable information concerning former exploration of his company at the Pyrites (High Falls) property.

Information concerning diamond drilling by the Shenango Furnace Company in the vicinity of the Little River deposit was given by A. L. Fairley, Jr.

Dr. A. F. Buddington was very helpful in calling to the writer's attention several areas meriting investigation during this study.

The base for the geologic map of the Pyrites prospect was made by Dr. J. R. Dunn, temporary geologist of the State Geological Survey.

Previous Work

The first real attempt to understand the geology of the St. Lawrence and Jefferson Counties pyrite deposits was made by C. H. Smyth, Jr., whose descriptions and discussions of ore genesis were published in 1912 as part of New York State Museum Bulletin 158. Smyth concerned himself primarily with the origin of the pyrite deposits. Martin (1916) described the pyrite deposits of the Canton quadrangle and briefly discussed their origin from the point of view of field relationships. Buddington (1917) made a brief study of the St. Lawrence and Jefferson Counties pyrite deposits principally to direct attention to the many undeveloped veins which were considered as possible sources of sulfur ore. His report, published as New York State Defense Council Bulletin No. 1, proved to be of great value in locating many of the pyrite localities in the course of the present study.

Cushing and Newland (1925) briefly considered the nature and distribution of the pyrite deposits within the Gouverneur quadrangle, but no detailed studies were reported. Miller (1926) in a brief paper discussed the origin of the pyrite ores of St. Lawrence County but added few new data. Buddington (1934) described the geologic setting and occurrences of the pyrite deposits in the Hammond and Antwerp quadrangles. His descriptions of the deposits were largely taken from his earlier report (1917). During the spring and summer of 1951 the St. Lawrence and Jefferson Counties pyrite deposits were scouted by several geologists representing a number of sulfur-producing companies, but the results of these cursory investigations were not, of course, made public.

A preliminary report, *The Pyrite Deposits of Jefferson and St. Lawrence Counties, New York,* written by the present author, was published in January 1953, as New York State Science Service Report of Investigation No. 8. It is intended that the present report should supersede the earlier preliminary report.

Geologic maps accompanying quadrangle geologic reports by Buddington (1934), Cushing and Newland (1925), Martin (1916), and Dale (1934) are helpful in orienting oneself in the regional geology.

GEOGRAPHY

The pyrite deposits of St. Lawrence and Jefferson Counties lie within the Grenville Lowlands region of the northwest Adirondacks, southeast of the St. Lawrence River. The region is characterized by northeast-trending ridges and valleys of moderate relief which reflect differential erosion of strongly deformed metasedimentary rocks and granites. Elevations above sea level range from around 400 to about 800 feet, but local relief seldom exceeds 100 feet and commonly averages about half that.

The entire region has been glaciated, and the topography has been modified by abrasion and by deposition of glacial materials. Preglacial drainage has been greatly disrupted by drift so that swampy ground is common in the region. Principal streams, such as the Indian, Oswegatchie and Grass Rivers, emptying into the St. Lawrence, occupy channels that are a combination of pre- and postglacial drainage courses. The cover of glacial sediments is not uniform, and over large areas the ice removed the mantle material and left behind scoured and polished bedrock.

Mining and dairy farming are the principal industries of the region. Zinc and lead, with some byproduct silver, are mined at Balmat, and zinc is mined at Edwards. These operations by the St. Joseph Lead Company are situated on opposite ends of the 10-mile-long Gouverneur talc belt. Along the belt commercial talc is mined by the Gouverneur Talc Company, the International Talc Company and the Reynolds Talc Company. Crushed stone, sand and gravel are also produced in the region.

Dairy farming is the principal agricultural activity. Most of the farms are situated on the low-lying marble belts, and much of the more-rugged terrane underlain by gneisses and granites is wholly undeveloped. The region was once heavily forested, but the timber has been mostly cut away and only second growth woodlands remain. Only a small amount of lumber is produced today.

Gouverneur, St. Lawrence County, is the principal village in the district. It serves as the trading center for the dairy farmers of the region and is the hub of the Gouverneur mining district. Canton, the seat of St. Lawrence County, is about five miles north of the northeastern limit of the pyrite district.

REGIONAL GEOLOGY

All of the known pyrite deposits of St. Lawrence and Jefferson Counties occur within the Grenville Lowlands region lying between the Adirondack highlands igneous complex on the southeast and the St. Lawrence River on the northwest. This low-lying region is a belt about 30 miles wide in which Precambrian Grenville metasediments and mixed rocks are greatly predominant over intimately associated granitic rocks. Abundant small outliers of flat-lying Cambrian Potsdam sandstone occur throughout the area. With a few local exceptions the rocks of the tightly compressed and isoclinally folded Grenville series possess a marked foliate structure parallel to the northeast regional trend of the lithologic units and major folds. The dips of the Grenville rocks progressively change from northwest through the vertical to southeast in passing from southeast to northwest. The Grenville series thus forms a great fan-shaped wedge lying between the large igneous complex of the Adirondack massif on the southeast and the granites of the Frontenac axis along the St. Lawrence River on the northwest.

The total thickness of the Grenville series in this region is probably in the neighborhood of 15,000-16,000 feet. In the absence of the usual criteria for ascertaining tops and bottoms of beds in this metamorphic terrane, there is some disagreement among workers as to top and bottom of the series. However, progressing from southeast to northwest across the Lowlands belt the sequence proposed by Engel and Engel (1953) is as follows (generalized):

		THICKNESS IN FEET
Southeast	Biotitic quartz-microcline gneiss.......	500-1,000
	Marble (mostly dolomitic), with interlayered pyritic schists and feldspathic gneisses	4,000
	Quartz-biotite gneiss, largely migmatitic, with occasional interlayers of amphibolite and marble	2,800
	Marble, with some interlayered quartzite and feldspathic gneisses	4,000
Northwest	Complexly interlayered marble, quartzite and biotitic, feldspathic and pyroxenic gneisses	4,000

There are two general types of granite within the area. These are (1) the Alexandria type, a medium-grained equigranular alaskite

occurring as phacoliths, and (2) the Hermon type, a medium- to coarse-grained rock ranging in texture from porphyritic granite to augen gneiss, with numerous local variations and grading locally into syenitic phases.

The granites of the region are all of Precambrian age. Most workers (Buddington, 1939; Dietrich, 1954; Cushing and Newland, 1925) consider the Alexandria type granite to be clearly of igneous origin. The Hermon type granite, however, is considered by Buddington (1939), Engel and Engel (1953) and others to be partly of magmatic origin and partly of replacement origin. Buddington (1939, p. 160) ascribes the origin of the Hermon granite "in part to permeation and modification of Grenville alumino-siliceous beds by solutions, in part to processes attendant upon intimate intrusion of magma into Grenville gneiss, granulite and amphibolite, perhaps in part already modified to the character of an augen gneiss by advance solutions, and in part to porphyritic crystallization of magma."

PYRITE DEPOSITS

History

The earliest recorded pyrite mining in the region was in 1883-84 at the Stella mine one mile north of Hermon, St. Lawrence County. With but few interruptions from that time until 1921, when all pyrite mining ceased in the region, one or more mines were active. Production from individual mines tended to be intermittent, and none of the mines was a really large producer.

The failure of the active mines shortly after World War I can be blamed directly on the sudden depression in the sulfur market occasioned by the cutbacks in munitions and general industrial production following the armistice. Furthermore, during the war period production of Gulf Coast brimstone was tremendously increased through government stimulation, so that by 1919 production greatly exceeded market demand. In addition, producers of sulfuric acid were beginning to find that native sulfur not only cost less originally, but it was also less expensive to use through all the processes of manufacture. Under these circumstances New York pyrite could no longer compete successfully with brimstone.

The Stella mine had the longest active history of any of the pyrite mines in the region. From its opening in 1883-84 until it was forced to close along with other mines around 1920-21 it produced over half a million long tons of concentrates averaging 40-45 percent sulfur. Until 1885 the Stella mine was the only pyrite mine operating in the region. The production of this early period was shipped to Canada and Detroit, probably as rough concentrates, to be used for sulfuric acid manufacture. In 1900 the mine closed down because of the financial failure of its owners, and it remained idle until 1904, when it was sold to the St. Lawrence Pyrite Company. From that time until the end of World War I the deposit was operated almost continuously, with production coming from several new shafts. In his report of 1913 McDonald rated the St. Lawrence Pyrite Company, controlled by Ladenberg, Thalmann & Co. of New York, one of the four principal pyrite-mining companies in the United States. So far as is known, all of the company's production came from the Stella property. Much of the concentrates was carried by rail 20 miles to Ogdensburg on the St. Lawrence River, where they were transferred to boats and shipped up the Great Lakes. In 1951 the property was acquired by the General Chemical Division, Allied Chemical and Dye Corporation, but no new development work has been initiated to date.

The Pyrites prospect (formerly referred to as High Falls) along the Grass River in and near the hamlet of Pyrites, about five miles south of the village of Canton, was first worked about 1886. Mining was carried on intermittently from that date until 1906, but production was small. The property was transferred in 1905 by McCray and Murphy, the original operators, to the National Pyrite Company of Canton. In 1907 the Oliver Iron Mining Company acquired an option on the property and conducted considerable exploration during the next year or so. A few hundred tons of ore were produced from a new shaft in 1907-8 and subjected to milling tests, although no large-scale mining was undertaken. The pyrite deposit is still owned by the Oliver Iron Mining Division, United States Steel Company, although no development work has been done since 1908.

The Cole mine, about five miles northeast of Gouverneur, was opened around 1900 by the Adirondack Pyrite Company. By 1905 it was the largest producer of pyrite in the region and shipped both raw ore and concentrates from its new mill. In 1906 the mine was taken over by the American Pyrites Company but in 1907 the mill was dismantled and all work ceased. Unreasonable royalty demands by the owners of the Cole property have been cited as the principal reason for this shutdown. The mine was reactivated by the Hinckley Fiber Company in 1910. The output was used in the manufacture of sulfite pulp at the company's paper mill at Hinckley, N. Y. In 1915 the Cole mine once more became inactive when the Hinckley Fiber Company discontinued the use of pyrite in the manufacture of sulfite pulp. In 1916 the property was leased to the St. Lawrence Pyrite Company, which began dewatering the mine and carried on some exploratory shot drilling. Subsequently, in 1917, the property was taken over by the New York Pyrites Company, Inc., which continued to operate the mine until it was finally shut down in the early part of 1921.

Development work on other prospects took place at various times prior to 1920, with especial activity being noted for 1904 on the Stiles, Mitchell, Farr and Hendricks properties and for 1918 on the Dickson, Wight, Morgan and Caledonia deposits.

Distribution

All of the more important prospects lie within the narrow belt extending 35 miles northeast from the vicinity of Antwerp. Three prospects (Kilburn, Pleasant Valley School, Little River) lie outside the 3- to 4-miles-wide belt defined above, but the deposits occur in rocks similar to those of the principal area.

Many of the prospects are grouped into well-defined narrow belts within which the individual deposits are closely related geologically and geographically. Within such belts it is best in some cases to consider the characteristics and potentialities of the belt as a whole, rather than of individual deposits as separate entities. Belts which will be considered as related groupings of individual prospects are the (1) Oxbow belt, which includes the Oxbow Southwest and Gold Hill prospects; the (2) Antwerp-Keene belt, which includes the Dickson, Wight, Morgan, Keene and Caledonia prospects; the (3) Bigelow belt, which includes the Cole mine and the Hendricks, Stiles, Mitchell and Farr prospects, and the (4) Hermon-Pyrites belt, which includes the Stella mines and the Pyrites mine. Five deposits—Kilburn, Pleasant Valley School, Ore Bed School, Little River, Brick Chapel—do not occur in any natural grouping and will be considered as individual prospects. The distribution of the pyrite deposits is shown on the index map, figure 2.

Production

Precise and complete records of pyrite production in St. Lawrence and Jefferson Counties are not available. Three types of shipping products were produced, run-of-mine ore, selected and partially-cobbed lump ore, and concentrates; but available production figures are not consistent in identifying the nature of the product for which tonnages are given. The best evaluation the author is able to make from available statistics indicates that the total production of all pyrite mines in the two counties during the period of active mining prior to 1921 was a little more than 600,000 long tons of concentrates, or equivalents, averaging about 40 percent elemental sulfur.

The Stella property was by a wide margin the principal producer of pyrite in the region. From the beginning of operations in 1883-84 until the mine was acquired by the St. Lawrence Pyrite Company in 1904, production was small and sporadic; but from 1904 until the property closed down shortly after the end of World War I, a total production in excess of 500,000 long tons of pyrite concentrates averaging 40 percent sulfur was attained.

During the intermittent periods of its operation between about 1900 and 1921 the Cole mine produced around 100,000 long tons of pyrite ore. The operation was begun as an open pit but ultimately went underground with workings several hundred feet deep.

Total production of all other mines and prospects probably did not exceed 20,000 long tons of ore.

Between 1901 and the close of pyrite mining in 1921, output from St. Lawrence County mines placed New York relatively high among

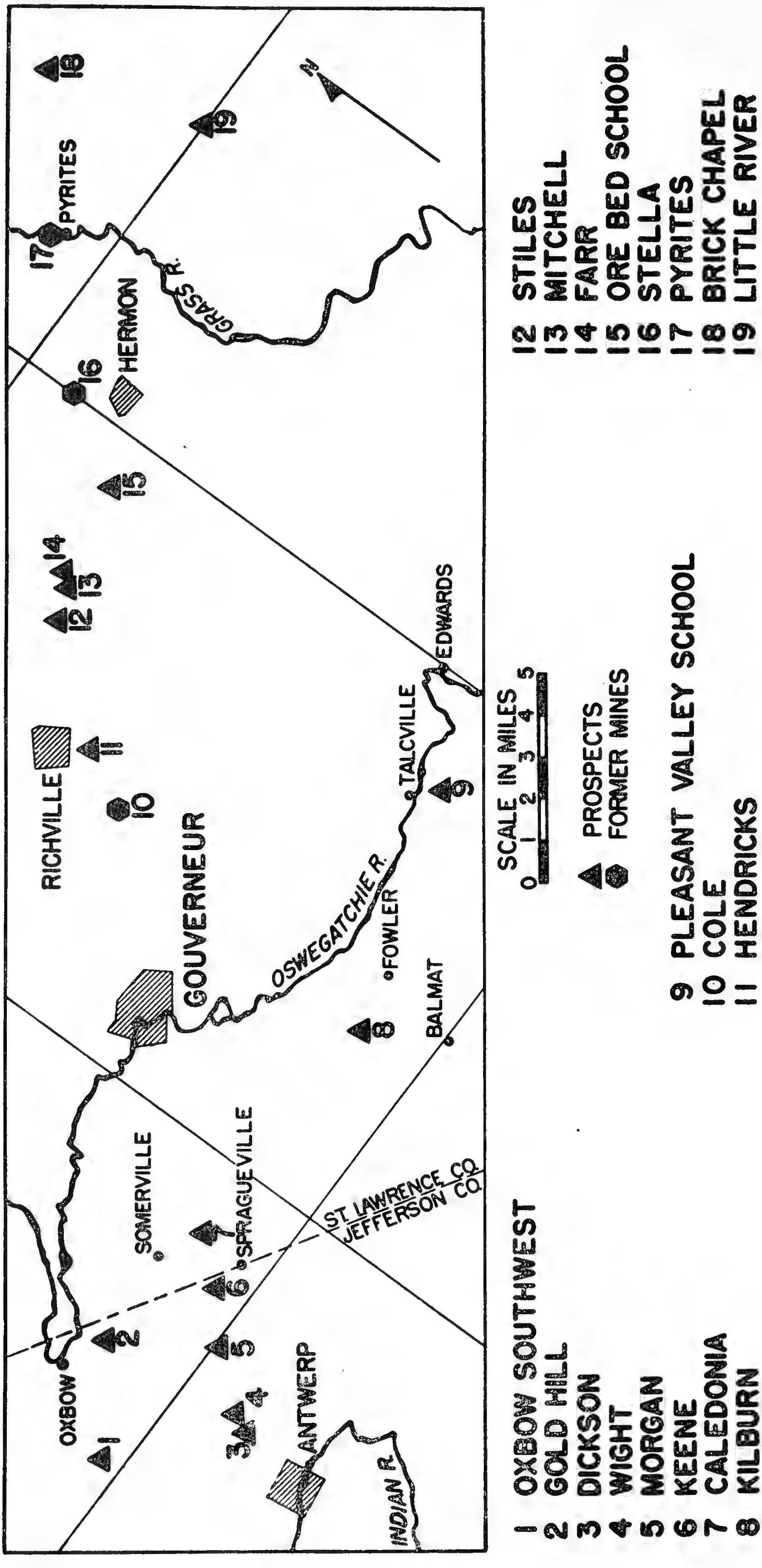


Figure 2. Map showing location of St. Lawrence and Jefferson Counties pyrite deposits

States in pyrite production. Fragmentary information gleaned from early editions of the U. S. Geological Survey's *Mineral Resources of the United States* indicates that New York State ranked fourth among States in tons of pyrite ore produced in 1901 and 1905. It ranked only tenth in 1902, but in 1914 it ranked second. In 1915 and 1917 New York ranked third in quantity of pyrite produced, but a small amount of the tonnage was byproduct pyrite recovered by the Northern Ore Company in the milling of zinc ore at Edwards.

General Character

The assemblage of ore minerals is exceedingly simple. Pyrite (FeS_2) and pyrrhotite ($Fe_{x-1}S_x$) are essentially the only sulfides present, although traces of chalcopyrite ($CuFeS_2$) and sphalerite (ZnS) have been noted in one or two instances. Arsenic sulfides are lacking. A very small amount of secondary hematite (Fe_2O_3) is the only metallic oxide found.

The pyrite of the ores is disseminated in a gangue of silicates characteristic of the rusty gneisses. Higher grade ore zones may include narrow veinlets and lenses of massive pyrite, but they constitute only minor parts of the mineralized zones. Where present, pyrrhotite occurs in the same manner as pyrite. The relative quantities of pyrite and pyrrhotite range widely from deposit to deposit. Pyrite is much more abundant than pyrrhotite, generally speaking, but locally within a given deposit pyrrhotite may be the dominant sulfide. Both sulfides occur together in some of the veins, but characteristically grains of each do not occur intimately intermixed. Rather, the pyrite and pyrrhotite tend to occur in discrete veinlets or lenses. Graphite is a fairly abundant gangue mineral in all of the deposits.

The pyrite content of the typical rusty gneiss generally runs only about 5 to 10 percent by volume. The potential ore veins contain pyrite concentrations many times greater but grade laterally into ordinary rusty gneiss.

The sheeted structure of some of the veins and the irregular distribution of pyrite in others necessitated the cutting of channel samples for analyses to determine the tenor of the potential ores. The entire width of a vein cannot, in most cases, be channel-sampled completely in outcrop or prospect workings, so that the values obtained should not be used to calculate average tenor of maximum tonnages available. Analyses of cores from appropriately spotted diamond drill holes are essential to a delimiting of foot wall and hanging wall cutoffs based on minimum allowable sulfur content.

Thirteen of the most promising deposits were channel-sampled and

analyzed for elemental sulfur content. It is believed that these analyses closely approximate the average tenor of the veins sampled, although acceptance of a lower-grade ore could greatly increase available tonnages. All channel samples were cut by hand, using a mall and steel moils. The channels cut averaged about 3 inches in width and 2 inches in depth. Constant width and depth were maintained for the full length of each channel, although the size of channels differed slightly among the various veins sampled. Where practicable the channels were cut normal to the walls of the veins; but where it was necessary to cut a channel at an oblique angle to the walls, a constant angle was maintained throughout the entire length of the channel.

Deposits which have been channel-sampled are the following: (1) Oxbow Southwest, (2) Gold Hill, (3) Dickson, (4) Wight, (5) Morgan, (6) Keene, (7) Cole, (8) Hendricks, (9) Stiles, (10) Mitchell, (11) Farr, (12) Pyrites and (13) Brick Chapel. The important Stella prospect was not channel-sampled because of the general inaccessibility of adequate thicknesses of the veins. Two grab samples of tailings at this locality were analyzed, however. A grab sample taken at the Little River deposit was also analyzed for sulfur.

With the exception of the Stiles deposit, all analyses of channel samples indicate an elemental sulfur content in excess of 20 percent by weight, with a range of from 20.2 percent in the Oxbow Southwest prospect to 35.6 percent in the Gold Hill. The relatively-poor Stiles deposit ran 15.2 percent elemental sulfur. The weighted average of all samples analyzed is 25.6 percent sulfur. It must be remembered, however, that the values obtained in no case represent complete sampling of a given deposit, although care was taken to make the samples as representative as possible. Available analyses of ore from the Pyrites deposit indicate a small amount of zinc and copper locally (cf. p. 76) but sulfides of zinc and copper were not found in polished specimens of the ore, and samples taken for this study were not analyzed for those elements. The results of the chemical analyses are summarized in table 1, along with pertinent sample data.

Mode of Occurrence

The pyrite deposits of St. Lawrence and Jefferson Counties occur in distinctive rusty-weathering pyritic gneisses belonging to the Precambrian Grenville series of metasedimentary and mixed-rock formations. These so-called rusty gneisses are essentially chloritic and graphitic quartz-feldspar-mica gneisses containing more or less disseminated pyrite, with or without pyrrhotite, that has partially altered to hydrous iron oxides of the gossan type. Though comprising a rela-

TABLE 1

Summary of Chemical Analyses of Pyrite Samples

(*Analyst: J. A. Graham*)

SAMPLE NO.	PROSPECT	TYPE OF SAMPLE	LENGTH OF SAMPLE IN FEET	DIP OF VEIN	MINIMUM THICKNESS IN FEET OF VEIN WHERE SAMPLED	REMARKS	% SULFUR *
1–51	Oxbow Southwest	Channel	1.5	40°	8	From northern part	20.2
2–51	Oxbow Southwest	Channel	3.0	90°	15	Sheeted zone, southern part	29.4
3–51	Oxbow Southwest	Channel	2.5	90°	15	Sheeted zone, southern part	29.6
4–51	Gold Hill	Channel	1.7	35°	30	Lower pyrite band	35.6
5–51	Gold Hill	Channel	2.1	35°	15	Sheeted pyrrhotite zone	24.1
7–52	Dickson	Channel	27.0	20°	15	Flat-lying outcrop on vein	24.8
4–52	Wight	Channel	25.0	50°	20	Taken on vein in prospect pit	30.9
6–51	Morgan	Channel	6.0	45°	8	From vein in trench	23.5
8–52	Keene	Channel	4.5	35°	12	On vein	29.3
7–51	Cole	Channel	2.5	30°	3	2d vein from top, at old shaft	29.3
8–51	Cole	Grab	—	—	—	Mill concentrates from open pile	36.5
3–52	Hendricks	Channel	3.0	65°	3	On vein	26.9
9–51	Stiles	Channel	5.0	40°	8	Wall of shaft portal	15.2
10–51	Mitchell	Channel	3.5	60°	5	Massive part of vein at shaft	28.3
11–51	Farr	Channel	3.7	90°	2	Cut obliquely across 2-foot vein in S W. corner of shaft	30.6
1–52	Stella	Grab	—	—	—	Tailings from large pile near highway	1.5
2–52	Stella	Grab	—	—	—	Tailings from large pile near highway	2.8
6–52	Pyrites	Channel	8.0	55°	8	West bank of Grass River	22.9
9–52	Little River	Grab	—	15°	12	On vein in river bottom	19.3
5–52	Brick Chapel	Channel	9.0	27°	15	On vein, S E. side of hill	26.2

* Analyses of all samples were run in duplicate. Sulfur percentage recorded is average of the two analyses in each case. Maximum deviation from average for a single analysis was 1.2 percent sulfur.

tively small part of the entire section, the rusty gneisses are nonetheless important and characteristic components of the Grenville series in the northwest Adirondacks. The rusty gneiss formations are comparatively thin but are notably persistent along the strike. In some cases thin bands of rusty gneiss less than 10 feet thick can be traced almost continuously for a mile or more. The rusty gneisses occur only within the major marble belts of the Grenville series but are closely associated with quartz-feldspar-biotite gneisses, thin-bedded quartzites and amphibolites, as well as calcareous and dolomitic marbles. Locally the rusty gneisses are capped by Cambrian Potsdam sandstone, and in the Antwerp-Keene belt the pyritic gneisses grade upward into hematite ores lying below Potsdam sandstone caps. The rusty gneisses, in common with almost all gneisses of the region, have been abundantly injected by granitic and pegmatitic solutions. In the Hermon-Pyrites belt metagabbro is intimately associated with the rusty gneisses.

The rusty gneisses are all strongly foliated and individual micaceous layers commonly are highly schistose. In many places the rusty gneiss is strongly laminated, reflecting shifts in the ratios of constituent minerals from layer to layer. The inch-scale layering is particularly conspicuous where the gneiss contains thin interlayers of quartzite, which tend to stand out in positive relief on weathered surfaces. The color of the rusty gneisses in outcrop ranges from dark reddish brown to yellowish green. In places deep weathering has formed gossan to a depth of a foot or more. In all occurrences disseminated pyrite—and in places pyrrhotite—is conspicuous.

Thin section studies show the rusty gneisses to be composed principally of quartz, feldspar, mica, chlorite, pyrite and graphite. Common minor constituents include hornblende, apatite, sphene, calcite, tremolite, epidote, clay minerals, garnet, tourmaline, zircon. In some cases pyrrhotite instead of pyrite is the iron sulfide present. Commonly both minerals are present in a given deposit, but they rarely occur together in a single thin section.

Microcline generally is the dominant feldspar, although sodic plagioclase may occur with the potash feldspar and in a few cases was seen to be more abundant than microcline. The micas present include both muscovite and biotite, and possibly a little phlogopite. The ratios among the constituent minerals range widely from deposit to deposit and from layer to layer within mappable units. Most commonly quartz is the dominant constituent and may comprise 50 percent or more of the rock. Feldspar, which generally is clouded with secondary clay minerals, commonly exceeds 30 percent of the rusty gneisses by volume. Chlorite, which replaces the micas and feldspars in large part,

is usually a major constituent also. Ordinarily the pyrite (and/or pyrrhotite) in the rusty gneisses does not exceed 5-10 percent of the rock by volume, but where concentrated into veins of potential ore it may be the dominant constituent. The veins are essentially loci of extreme concentration of pyrite within otherwise ordinary rusty gneisses. Such local concentrations of pyrite are usually correlative to exceptional concentrations of chlorite and graphite.

The ordinary rusty gneisses show a marked foliate texture in thin section. Most conspicuous are the long narrow spindles of quartz oriented parallel to the foliation and the similarly oriented blades of mica. Commonly the disseminated pyrite, too, is present as oriented elongated grains. Where the pyrite is concentrated into veins of potential ore, however, the microscopic foliate textures generally are lacking and the textures are more uniform. Compositional banding within the ores nonetheless reflects the overall foliation of the gneisses.

Structure of the Pyrite Veins

The Grenville rocks and their constituent rusty gneisses have all been subjected to severe regional stresses and metamorphism and have been isoclinally folded and overturned toward the southeast so as to dip northwest at angles ranging from 20° to 90°. The pyrite veins occur as thin sheets lying parallel to the foliation of the enclosing rusty gneisses. Locally the veins pinch and swell along the strike and down the dip so as to appear lenticular.

The veins appear to be very persistent along the strike and down the dip. At the Pyrites prospect, for example, the vein is exposed more or less continuously for a distance of six-tenths of a mile along the Grass River. McDonald (1913, p. 690) wrote that the upper vein at the Stella prospect extends 1,100 feet along the strike and had been worked to a depth of 900 feet down the dip. According to Buddington (1917, p. 22) the veins in the Anna shaft at the Stella prospect had been mined for 1,800 feet along the strike and were proved by diamond drilling to extend much further.

In at least six of the 19 deposits, the pyrite mineralization occurs in zones of intense local folding and crumpling of the rusty gneiss, but it is not advocated that such local deformation provided a structural control of pyrite concentration. This viewpoint is more easily appreciated when it is understood that in more than two-thirds of the deposits no such local distortion is superimposed upon the regional structure and that similar local structures entirely devoid of pyrite mineralization are so common as to be characteristic of the Grenville rocks in general.

Mineralogy and Paragenesis

PYRITE

This ore mineral, containing 53.4 percent sulfur by weight, occurs as disseminated grains, coarse knots, reticulating stringers and cross-cutting dikelets in rusty gneiss gangue. Generally the disseminated pyrite is present as rounded and irregular grains, but locally there is a marked tendency toward euhedral development—especially where the pyrite has grown in a chlorite groundmass. Commonly the pyrite grains are elongate and are oriented parallel to the foliation trends in the enclosing rusty gneiss. The maximum diameter of individual grains ranges from fractions of a millimeter to more than eight centimeters. In most cases the pyrite is wholly recrystallized but locally it may be severely broken along tiny crush zones.

The pyrite has crystallized later than all of the gangue minerals, with the possible exception of sericite (cf. Smyth, 1916, pp. 147, 148) and partially replaces them. It penetrates along fractures and cleavages in the gangue minerals and forms characteristic "caries" replacement textures, but often there is a marked tendency for idiomorphic development of pyrite in such replacement contacts. The pyrite also occurs interstitial to the gangue minerals, upon which it molds, and it commonly fills late fractures in the gangue.

The pyrite appears to replace chlorite most readily of all the gangue minerals, or at least it is commonly most abundant in a chloritic groundmass and exhibits a very strong tendency toward idiomorphic development against the chlorite.

Many of the pyrite grains are seen in polished section to have narrow rims of hematite, which are presumed to be secondary after the pyrite. In a few grains studied the hematite was developed along minute fractures in the pyrite.

PYRRHOTITE

Pyrrhotite, which contains about 38.4 percent sulfur by weight, exhibits the same general relationship to the gangue minerals as does pyrite, except that it generally lacks the distinct granularity characteristic of pyrite. Typically the pyrrhotite occurs as very coarse, amoeboid grains replacing and cross-cutting the gangue minerals. As in the case of pyrite, the pyrrhotite is particularly abundant in chloritic groundmasses but lacks any idiomorphic development. A few discrete grains of hematite were noted in association with pyrrhotite in several polished sections, but no replacement rims of hematite on pyrrhotite were seen.

HEMATITE

The hematite content of the ores is very low and averages somewhat less than 1 percent. For the most part it occurs as narrow replacement rims on pyrite grains. To a limited extent it occurs as scattered discrete grains in the ore but probably is wholly secondary after pyrite.

GRAPHITE

This mineral is relatively abundant in all of the ores. Characteristically, increases in graphite content parallel increases in pyrite content. The graphite, like the pyrite, has crystallized very late and replaces earlier gangue minerals in a manner quite similar to that of the pyrite. Typically, the graphite occurs as bladelike aggregates of minute flakes, as highly irregular aggregates and as thin rod-like stringers filling late cracks in the gangue. Graphite and pyrite appear to be essentially contemporaneous in final crystallization, and immediate geometric relationships between the two may indicate either one to have been slightly later than the other. For example, veinlets of graphite fill cross-fractures in pyrite; yet it is common for graphite to be wholly enclosed within pyrite. An interesting association of the two minerals is seen in occasional euhedral grains of pyrite bounded on all sides by narrow tabular borders of graphite. In a few instances a very narrow zone of chlorite or muscovite was seen to lie between the pyrite and the bordering graphite, all of which strongly suggests differential replacement of some earlier zoned silicate grain.

CHLORITE

A light green chlorite is very abundant in all of the ores and associated rusty gneisses. Typically it occurs as fine-grained aggregates replacing all of the gangue silicates, but it is especially abundant as a replacement of biotite, feldspar and hornblende. Commonly it forms veinlike aggregates filling late fractures cutting across all other minerals, including pyrite, and it is abundant interstitial to the other gangue minerals. Veinlets of chlorite filling fractures crossing earlier chlorite aggregates, as seen in occasional thin sections, indicate ready mobility of the chlorite up to the latest stage of crystallization.

FELDSPAR

Microcline is the most abundant feldspar in the gangue. Commonly it is the only feldspar present in a given thin section of ore, but in other cases it occurs along with minor orthoclase and sodic plagioclase. Almost without exception the potash feldspars are at least partially altered to clay minerals and perhaps sericite, and frequently individual grains are altered almost beyond recognition. In a few sections studied,

the dominant feldspar was sodic plagioclase, in part antiperthitic. The plagioclase, too, is highly altered and commonly chloritized, so that a precise determination of the anorthite content could not be made.

HORNBLENDE AND BIOTITE

These two mafic minerals constitute only a minor part of the ore—seldom more than 5 percent by volume. The biotite, in part at least, is secondary after hornblende, and both minerals typically are largely altered to chlorite. It seems probable that prior to chloritization hornblende and biotite were major constituents of the gangue.

MISCELLANEOUS GANGUE MINERALS

These include the common minor constituents of the typical rusty gneisses: apatite, sphene, calcite, tremolite, epidote, clay minerals, garnet, tourmaline, zircon. The calcite and tremolite reflect inherent calcareous zones in the parent rusty gneisses. Locally a little calcite appears to have mobilized and recrystallized very late to form minute fracture-filling and interstitial veinlets. The small amount of epidote present is secondary after plagioclase. The clay minerals result from alteration of the feldspars, both plagioclase and the potash feldspars. At least some of the tourmaline was probably introduced by the granitic solutions which have injected the pyritic gneisses locally. The derivation of the apatite, sphene, garnet and zircon is uncertain.

PARAGENESIS

The sequence of final crystallization of the principal minerals in the ores is summarized in figure 3. Paragenetic relationships of the minerals in the ores and associated rocks are shown in plates 1-5.

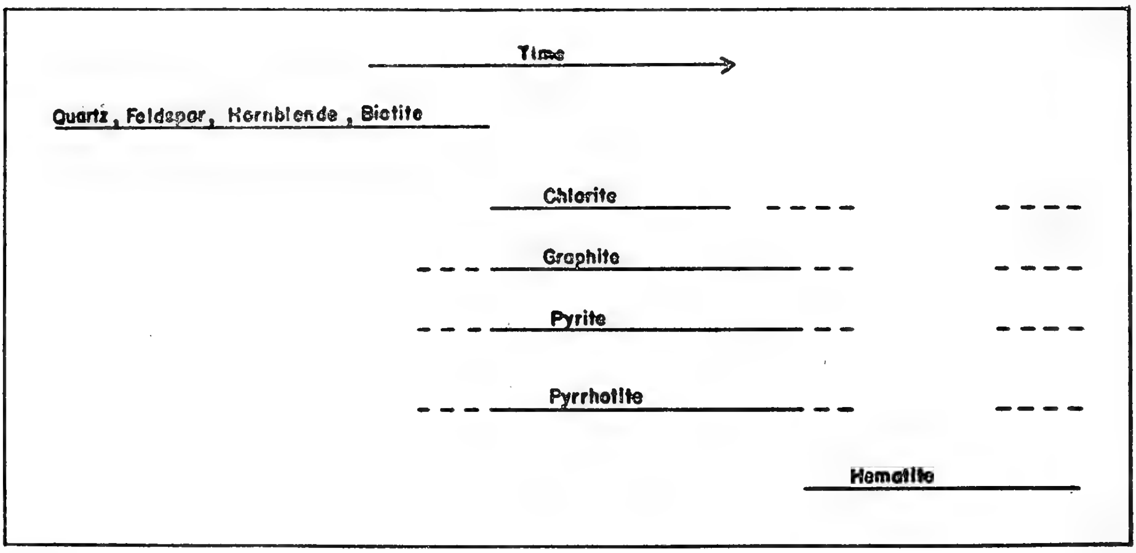
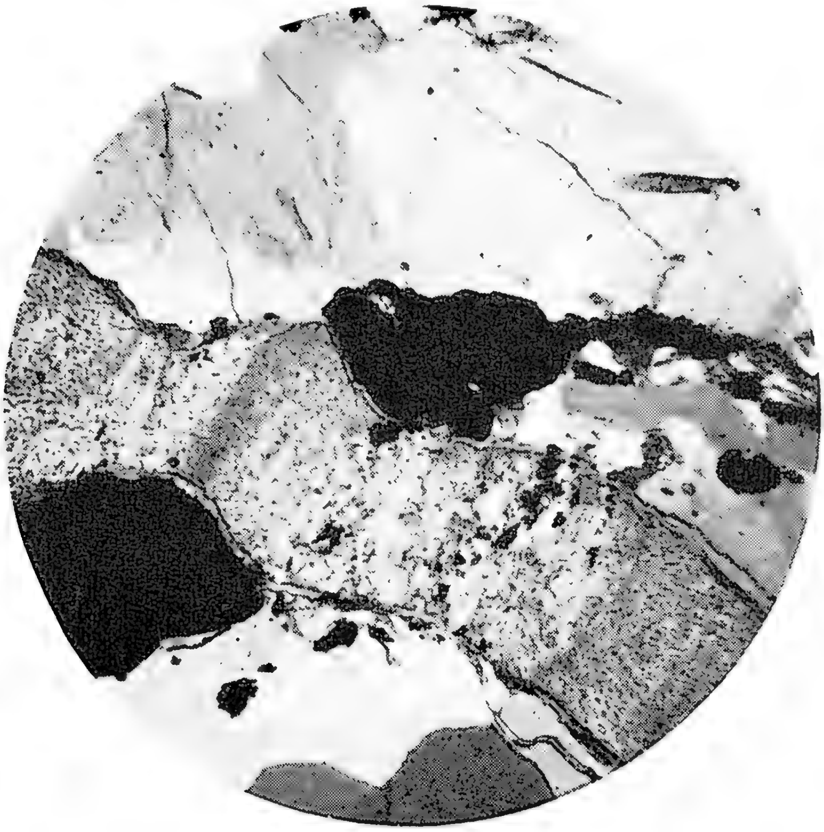
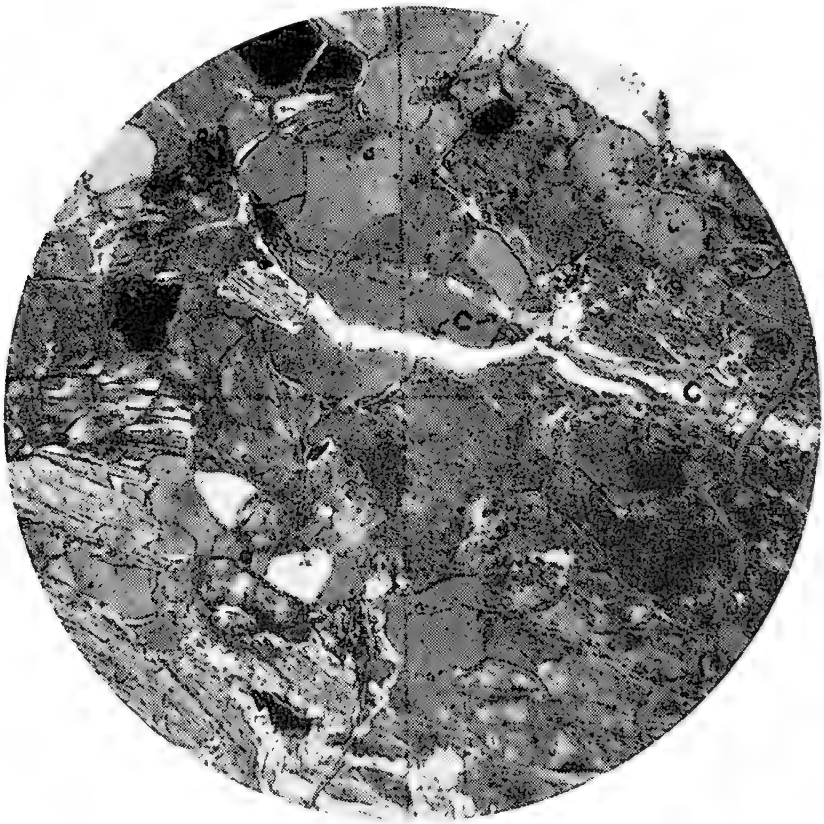


Figure 3. Diagram showing sequence of final crystallization of the principal minerals of the ores

PLATE 1

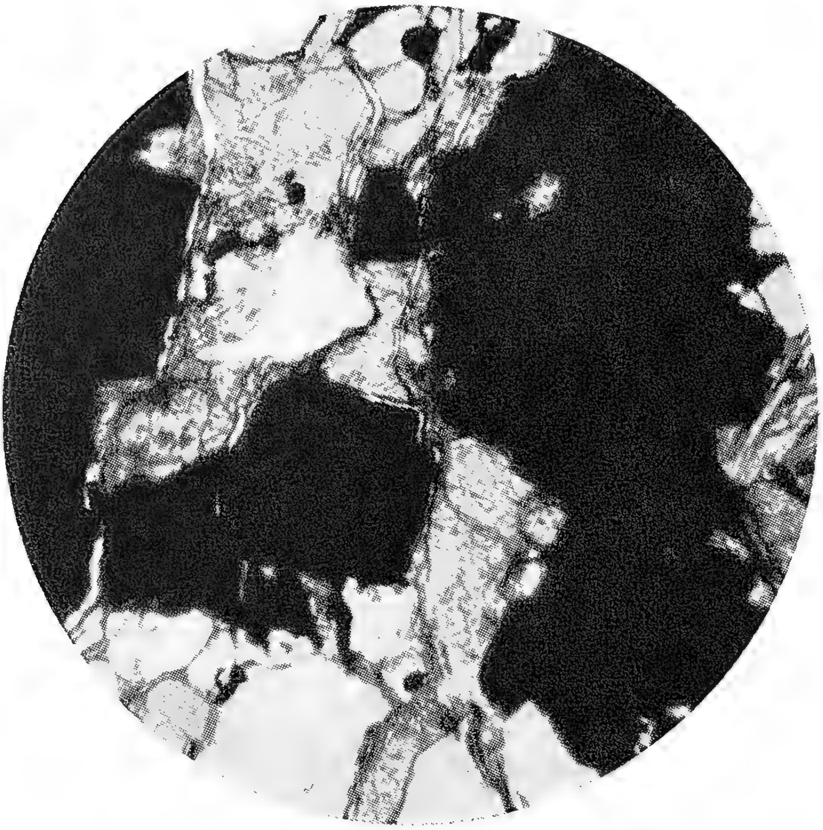


A. Photomicrograph of pyritic rusty gneiss from portal of southern shaft at Pyrites prospect showing late chlorite veinlet cutting across pyrite, quartz and feldspar. Crossed nicols. X110



B. Photomicrograph of rusty gneiss from outcrop on right bank of Grass River above lower bridge at Pyrites showing chlorite veinlets (c) cutting across quartz and chloritized feldspar and biotite. Note veinlet of later quartz cutting across chlorite veinlet on right hand edge of field. Crossed nicols. X110

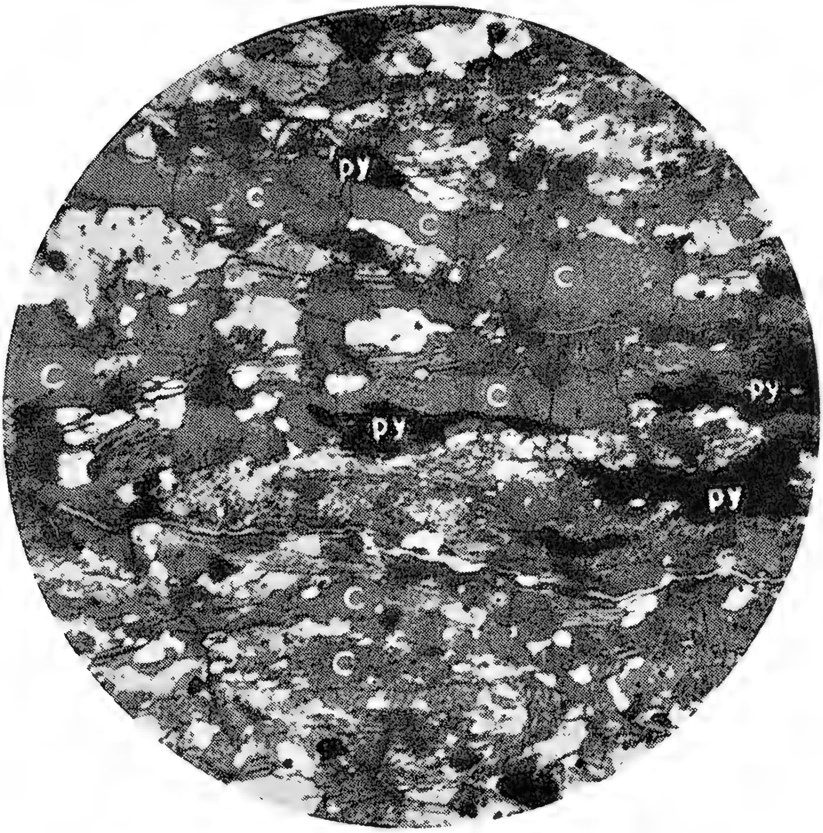
PLATE 2



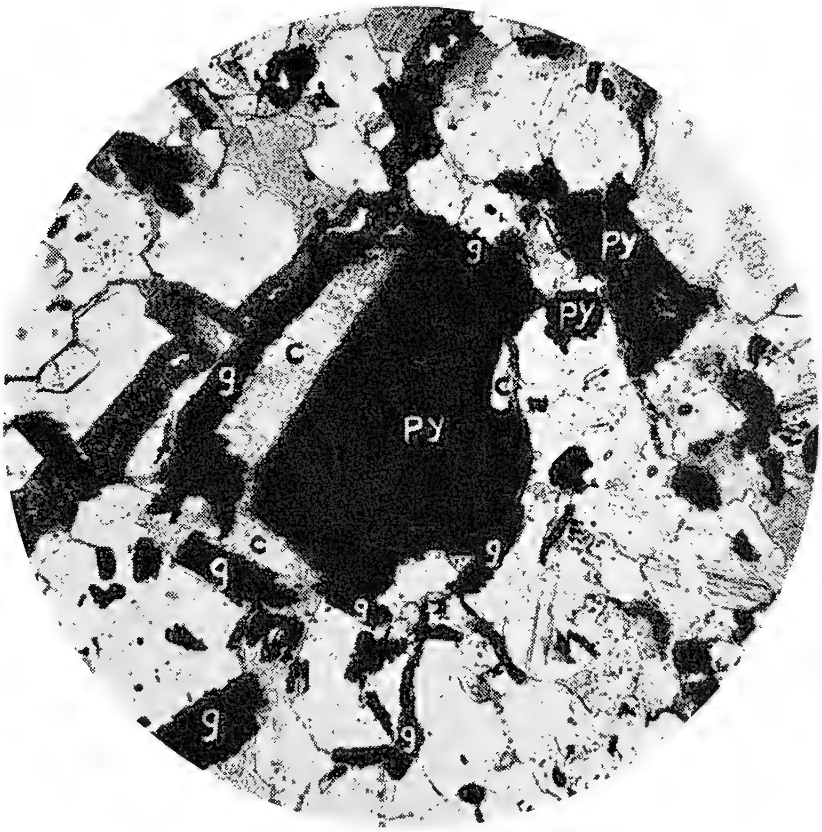
A. Photomicrograph of pyrite ore from portal of shaft at the Stiles prospect showing idiomorphic development of pyrite (black) in gangue of quartz (white) and chloritized feldspar and biotite. White partial rims on pyrite in right half of field are quartz. Nicols partly crossed. X110

B. Photomicrograph of pyritic rusty gneiss from outcrops in bank of Elm Creek at Stella prospect showing irregular grains of pyrite replacing gangue of quartz (white) and highly chloritized feldspar and biotite. Ordinary light. X110

PLATE 3



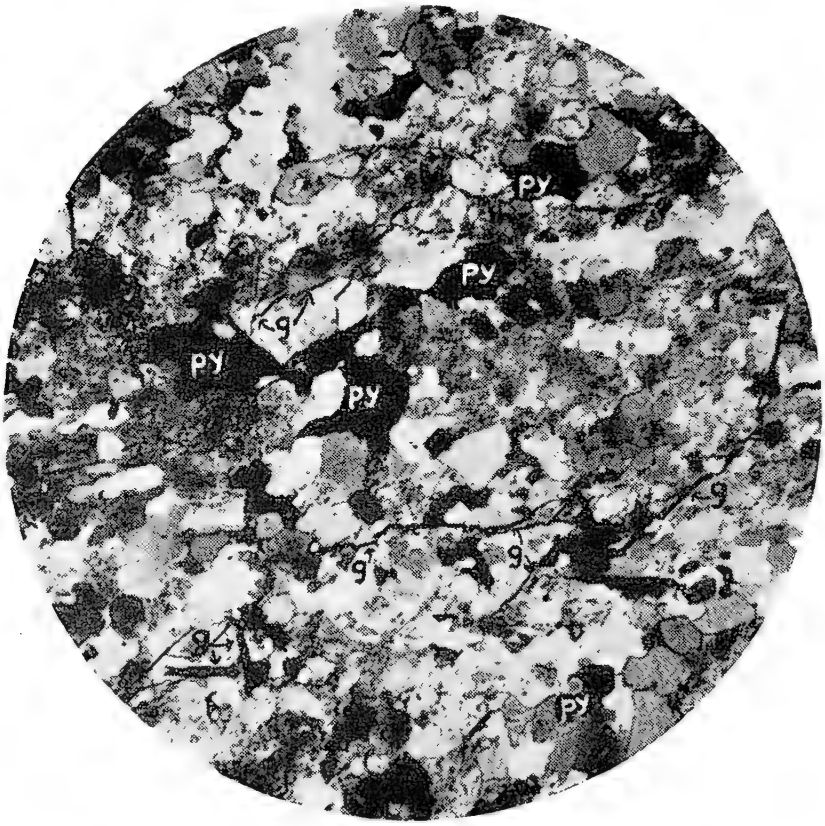
A. Photographic projection of thin section of schistose rusty gneiss from Stiles prospect showing irregular grains of pyrite (py) in strongly foliated, chloritized (c) matrix. The clear grains are largely quartz. Crossed polaroids. X15



B. Photomicrograph of pyritic rusty gneiss from Kilburn prospect showing pyrite (py) partially rimmed by chlorite (c) and graphite (g) in a manner suggesting selective replacement of a zoned crystal. Note abundant graphite and chlorite throughout the section. Ordinary light. X110

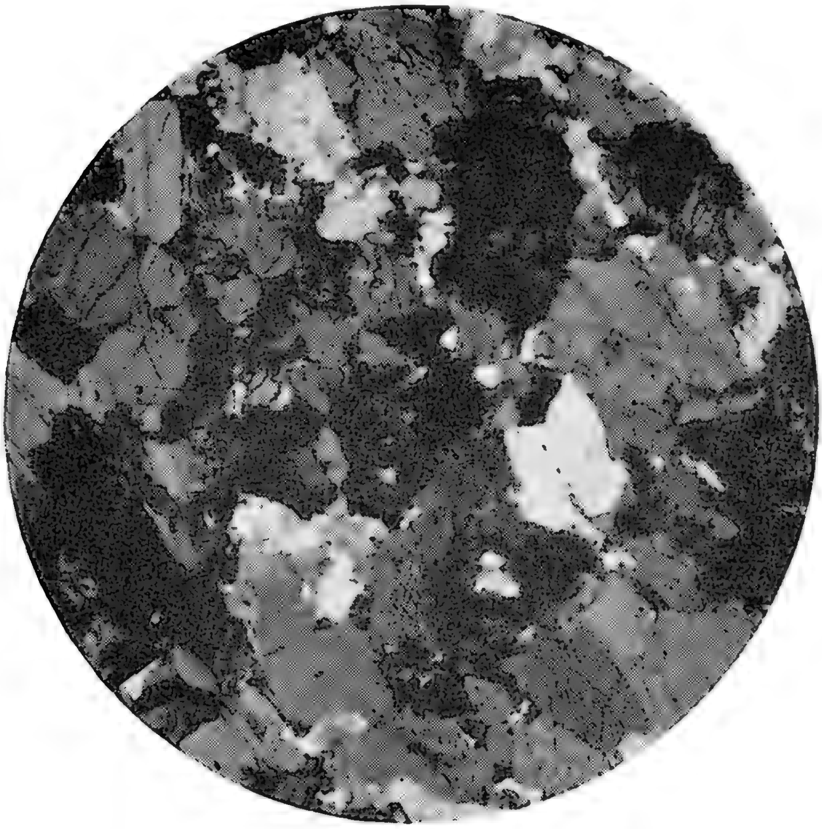
PLATE 4

A. Photographic projection of thin section of rusty gneiss from the A vein at the Stella prospect. The irregular opaque grains are pyrrhotite. Crossed nicols. X15

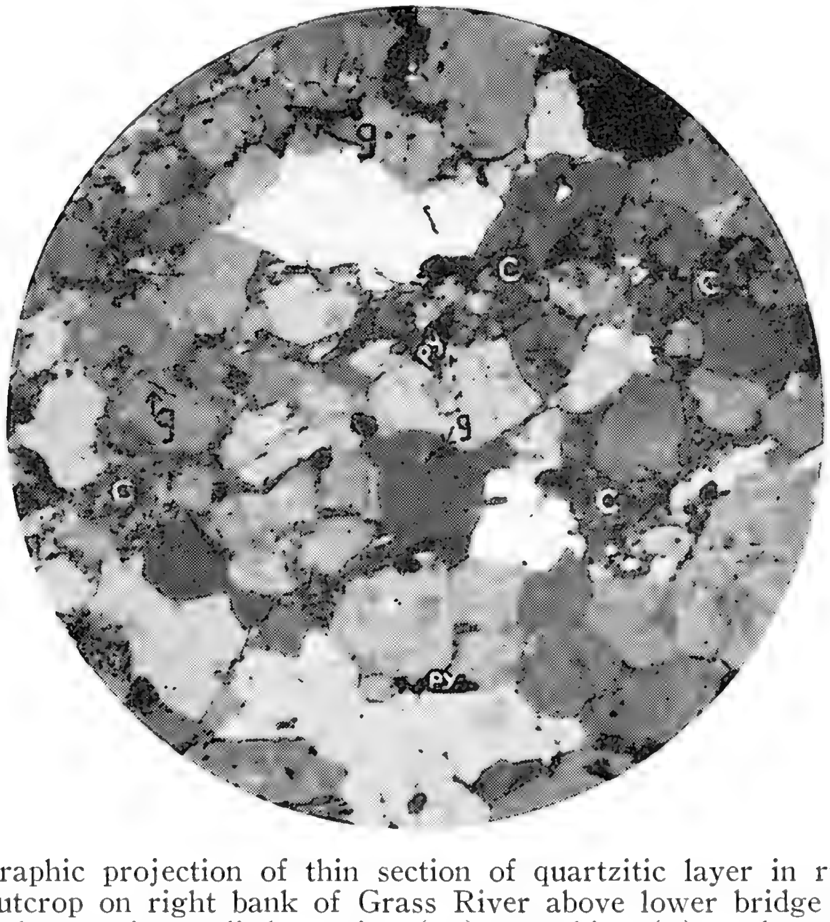


B. Photographic projection of thin section of pyritic rusty gneiss from the Keene prospect showing irregular grains of pyrite (py) and short stringers of graphite (g) in a slightly chloritized matrix of quartz and feldspar. Crossed nicols. X15

PLATE 5



A. Photographic projection of thin section of metagabbro from vicinity of paper mill ruins at the Pyrites prospect. The rock here is essentially a hornblende-plagioclase gneiss with a little quartz. Crossed nicols. X15



B. Photographic projection of thin section of quartzitic layer in rusty gneiss from outcrop on right bank of Grass River above lower bridge at Pyrites. The rock contains a little pyrite (py), graphite (g) and aggregates of chlorite (c). Crossed nicols. X15

Origin of the Pyrite Deposits

GENERAL STATEMENT

The problem of the origin of the pyrite deposits of St. Lawrence and Jefferson Counties is a complex one for which no unequivocal solution has been worked out. Clearly the genesis of the pyrite deposits is closely related to the problem of origin of the rusty gneisses in which they occur; but though several hypotheses may be developed which are compatible with all of the factual data in hand, the final interpretation depends in large measure upon the relative importance subjectively accorded the various factors involved. The complexity of the problem was well appreciated by Smyth (1912), whose valuable study exposed the many facets meriting consideration. The reader is urged to study Smyth's important contribution, of which only the principal conclusions will be reiterated in this report.

Essentially the problem reduces to the question of whether the pyrite was indigenous to the sediments from which the rusty gneisses were derived, or whether it was hydrothermally introduced, or whether it resulted from chemical combination of original components of the rusty gneisses with hydrothermally introduced elements. Lack of precise knowledge of the physicochemical conditions under which the pyrite was formed or recrystallized makes positive evaluation of the various possibilities impossible.

The present writer, taking full cognizance of the mineral assemblages involved and the specific characteristics of individual occurrences, will attempt to evaluate the problem in terms of the regional geology. The marked similarity of all the deposits demands an interpretation which will fit all cases.

PREVIOUS INTERPRETATIONS

Newland (1908, p. 51) drew a close parallel between the pyrite deposits and the magnetite deposits of the northwest Adirondacks. He stated, "Though inclosed by sediments the [pyrite] deposits can scarcely be construed as original beds of contemporaneous formation, but their genesis probably has been parallel to that of the magnetites found in the Grenville which are always pyritic and not rarely richly so. . . . The pyrite seems to have impregnated and replaced the schist to a great extent, at the same time filling small fissures and seams along the bedding planes. Its origin is traceable to iron-bearing solutions which have circulated through the schist when it was probably at considerable depth from the surface and perhaps in a less metamorphosed condition."

Smyth (1912, p. 180) proposed a complex origin for the pyrite deposits. He stated, "In summing the matter up on the basis of present data, it appears to the writer that four periods of pyrite formation are probable: (1) A primary precipitation of pyrite contemporaneous with the formation of the sediments; (2) a concentration of this pyrite by circulating ground waters, with the addition, perhaps, of pyrite of deep-seated origin, before the period of metamorphism; (3) but of minor importance, a recrystallization of all pyrite, accompanied perhaps by a certain amount of formation of new pyrite during metamorphism; (4) a further development and concentration of pyrite by magmatic agencies, perhaps working in combination with ground waters, as outlined above, following the period of active igneous intrusion and metamorphism."

Smyth (op. cit., p. 182) attempted an evaluation of the relative importance of each of the four periods proposed: "While, on the assumption that the four periods of concentration are well established, there is still room for much difference of opinion as to their relative importance. From what has been said above it is evident that the writer regards original sedimentation as merely of potential importance affording only disseminated pyrite which would demand great concentration to be available. Such concentration may have been effected to a considerable degree in the hypothetical second or ground water period, was probably not greatly influenced in the third or metamorphic period and was chiefly accomplished in the fourth or postmetamorphic period, during which minerals formed in the third or metamorphic period were broken down and replaced by others, of which pyrite is the most important. That much of the pyrite was actually deposited in its present form and place during this period is certain; that the ore bodies are to a large degree the products of this deposition is the conclusion reached from the evidence now available."

Martin (1916, pp. 42-47) concluded from his study of the field relations of the pyrite occurrence at Pyrites that the pyrite was primarily of sedimentary origin, and that igneous effects, if indeed there were any at all, were limited to the reconcentration of material already a constituent of the rusty gneisses.

Miller (1926) concluded that the principal source of the pyrite was the Grenville rusty gneisses themselves rather than cooling magma. According to his view, initially disseminated pyrite in the rusty gneisses was taken into solution by penetrating liquids and vapors from granites and pegmatites and carried to higher levels to be redeposited in more concentrated form.

Buddington (1939, pp. 178-180), and Leonard (1951) believe that

the pyrite deposits are of hydrothermal replacement origin. They point out that the distribution of the pyrite deposits fits into the zonal arrangement of Adirondack mineral deposits and suggest that they represent the low-temperature phase of replacement by hypogene ore carriers spreading outward from the core of the Adirondacks.

Engel and Engel (1953, pp. 1056-1057), in referring to the schistose rusty gneiss containing the Kilburn prospect, conclude that the pyrite largely is indigenous to the parent sediment. They state: "The pyritic, graphitic schist undoubtedly has evolved from an argillaceous and somewhat calcareous sandstone, which may have contained much of the iron and sulfur combined in the pyrite as sedimentary or diagenetic constituents."

PRESENT INTERPRETATION

The writer tentatively considers the pyrite deposits of St. Lawrence and Jefferson Counties to be concentrations of iron sulfides formed from inherent constituents of the parent sediments from which the rusty gneisses were derived. The exact character of the original sediments can only be a matter of speculation, for they have been thoroughly recrystallized during regional metamorphism and modified by the granitic solutions that moved through all of the Grenville rocks in the region. However, it seems likely that the parent sediments were argillaceous sandstones containing abundant organic impurities and some intercalated calcareous layers. The late-stage formation of abundant chlorite and the evident mobilization and recrystallization of sulfides and graphite well after the period of metamorphism are attributed to the late circulation of aqueous solutions which pervaded the entire region.

A number of considerations militate against the interpretation of the pyrite deposits being of hypogene origin. In the first place the complete relegation of the deposits to a particular rock type—the rusty gneisses—strongly suggests a sedimentary or diagenetic origin for the iron sulfides. The pyritic rusty gneisses occur as indigenous formations of the Grenville series and clearly represent a characteristic metasedimentary type interlayered with typical Grenville marbles and paragneisses. The rusty gneisses are not restricted to a precise horizon, but they are restricted to the major marble belts and appear to represent a phase of sedimentation marking the shift from clastic to chemical sediments. Hence, the rusty gneisses lie close to the contacts between the marble belts and the quartzose-feldspathic gneisses. Individual layers of rusty gneiss only a few feet thick intercalated with marbles and related metasediments commonly can be traced for thousands of feet along the strike and locally serve as reliable horizon markers, yet

lithologically they are remarkably uniform throughout and the iron sulfides are wholly confined to them. Contacts between the rusty gneisses and other closely associated metasediments typically are sharp, and local cross-veining of the rusty gneisses by apparently remobilized sulfides is strictly intraformational. The writer believes that any such precise stratigraphic selectivity by sulfide-bearing hypogene solutions is improbable.

The simplicity of the sulfide mineral assemblage in the rusty gneisses and associated pyrite deposits also casts serious doubt on the idea that the iron sulfides represent the low-temperature phase of replacement by hypogene ore carriers spreading outward from the core of the Adirondacks. The Kilburn and Pleasant Valley School prospects occur within a few thousand feet stratigraphically of the mineralized zones of the Balmat, Hyatt and Edwards mines of the Edwards zinc belt, and they surely occupy approximately the same temperature zone as that of the zinc mines. Yet the sulfides of the rusty gneisses consist of only pyrite and pyrrhotite in significant amounts. The galena, abundant sphalerite and minor chalcopyrite and barite of the Balmat, Hyatt and Edwards mines are lacking in the pyrite deposits of the rusty gneisses. Brown (1936, pp. 249-253) points out that the pyrite of the zinc ores in the Edwards district was the earliest of the ore minerals to form, although some possibly continued to form in decreasing amounts throughout most of the period of sulfide deposition. It becomes difficult, then, to consider the sulfides of the rusty gneisses as lower-temperature, and possibly later, hypogene minerals—especially since there is no evidence in the zinc mines for such a period of pyrite-pyrrhotite mineralization. The occurrence of abundant iron sulfides in the quartzose-feldspathic rusty gneisses is at complete variance with the marked tendency of the pyrite and other sulfides of the zinc deposits to replace moderately silicated marbles.

A further line of evidence strengthens the case against the rusty gneiss pyrite deposits being of hypogene origin. The belt of rusty gneiss containing the old pyrite workings at Pyrites appears to be wholly enclosed in metagabbro and is considered to be a xenolith caught up by gabbro magma which invaded the Grenville rocks. The rusty gneiss and related pyrite is wholly typical of similar rock types considered in this report. There is no evidence whatsoever that late sulfide-bearing solutions passed through the metagabbro to deposit pyrite and pyrrhotite in the gneiss xenolith. The metagabbro contains only traces of accessory pyrite, as do most of the rocks of the region. Smyth (1912, p. 178) pointed to the improbability of the gabbro being the source of sulfide-bearing solutions. It thus appears that the sulfide

material of the rusty gneiss band at Pyrites must have been part of the gneiss before the gneiss was engulfed by the gabbro, although the local concentration and recrystallization of the sulfides may have been much later. Similarly, metasedimentary rocks closely associated with rusty gneisses elsewhere in the region appear to have been wholly unaffected by sulfide-bearing solutions which would surely have had to pass through them if such solutions were to account for the formation of the pyrite deposits.

Of particular significance is the abundance of graphite in all of the rusty gneisses and the marked parallelism between pyrite and graphite in regard to local concentration of each. Practically all of the Grenville metasediments contain at least traces of flake graphite, but the graphite content of the rusty gneisses is abnormally high and almost certainly reflects abundant carbonaceous material in the original sediments.

The development of iron sulfides in marine sediments rich in organic matter is well known. Under reducing conditions hydrogen sulfide (H_2S) can be produced by bacterial action on sulfur-bearing organic compounds, and the presence of hydrogen sulfide may cause precipitation of iron sulfides. Rankama and Sahama (1950, p. 750) indicate that in such reactions ferrous sulfide is considered to be the precursor of pyrite, and they point out that such rocks may also contain pyrrhotite and other sulfides.

According to Marmo and Mikkola (1951, p. 37-38), who describe the carbonaceous sulfide-bearing schists (Precambrian) of Finland, either pyrite or pyrrhotite may form by the recrystallization of authigenic ferrous sulfide, depending upon the partial pressure of sulfur during the recrystallization. Pyrrhotite is considered to form according to this equation:

$$(1) \qquad Fe(OH)_2 + H_2S = FeS + 2H_2O^1$$

However, if the partial pressure of sulfur is great enough pyrite will form by this reaction:

$$(2) \qquad Fe(OH)_2 + H_2S + S = FeS_2 + 2H_2O$$

According to Väyrynen (1935, p. 16), if the concentration of hydrogen becomes strong enough, the concentration of sulfur will decrease concurrently according to the following formula:

$$(3) \qquad \frac{S}{4} = \frac{k}{2^2} \frac{(H_2S)}{(H)^2}$$

The reaction rate will then increase in favor of equation (1) and replacement of pyrite by pyrrhotite is possible.

[1] The simplified formula for pyrrhotite (FeS) is used to facilitate the balancing of the equation.

Thus it may be that at least some of the pyrrhotite in the rusty gneisses is a replacement of earlier pyrite, but the significant point is that pyrrhotite is not necessarily a product of high-temperature hypogene solutions.

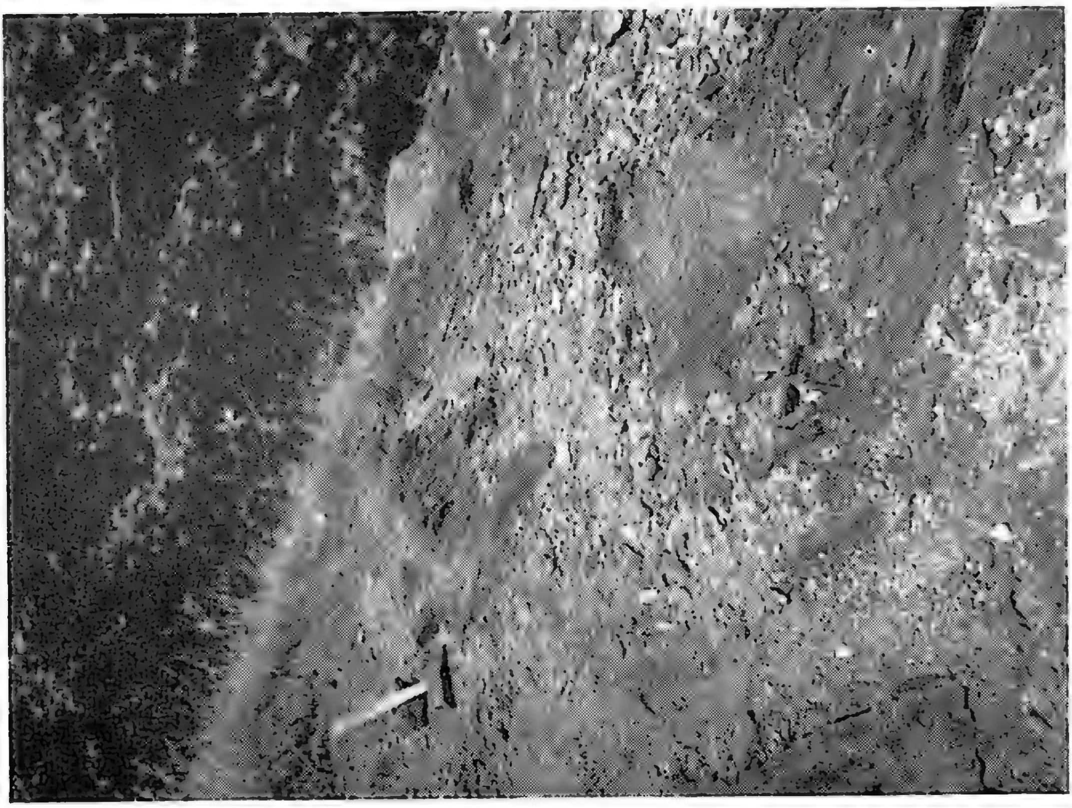
Galliher (1933, p. 58) states that the iron sulfide content of marine black muds seldom exceeds 2 percent. Gilbert (1954, p. 375), however, points out that many of the Precambrian black slates and graywackes of the Lake Superior region are highly pyritic, and he mentions black graphitic slates in the Iron River district in Michigan containing as much as 40 percent authigenic pyrite.

Petrographic evidence is abundant that aqueous solutions were plentiful in the rusty gneisses during the period of final crystallization of the pyrite and associated pyrrhotite and graphite. The abundant secondary development of hydrous minerals such as biotite, chlorite, clay minerals and muscovite or sericite penecontemporaneously with the pyrite establishes this point beyond reasonable doubt. The exact composition of the aqueous solutions is not known, of course; but there is little doubt that they facilitated the intraformational mobilization, concentration and recrystallization of the pyrite and graphite, in addition to contributing to the formation of hydrous secondary minerals. The ready mobility of both pyrite and graphite under similar conditions is well established.

The abundant development of chlorite, so characteristic of the rusty gneisses, is not understood. Clearly the chemical environment producing the chlorite was distinctly different from that in all other paragneisses of the Grenville in the region; for in no other rock type is chlorite so abundantly developed, yet all of the Grenville paragneisses show evidence of secondary formation of hydrous minerals. Tentatively the writer must beg the question and agree with Smyth (1912, p. 167) that the chloritization ". . . appears to be the result of unusually potent chemical agents associated with the formation of pyrite."

PLATE 6

A. View of Gold Hill from covered area to the south. The trend of the magnetic anomaly over the covered area carries it to the left of the two trees in the middle distance. Rusty gneiss outcrops are conspicuous near top of the hill. The outcrops on the right flank of the hill are garnetiferous quartz-biotite gneiss.



B. Strongly plicated sheeted pyrite vein cropping out on south end of Oxbow Southwest prospect

MINES AND PROSPECTS

Oxbow Belt

The two prospects in this belt, the Oxbow Southwest and the Gold Hill, occur on the limbs of the Sherman Lake syncline, south of Oxbow. This overturned fold involving the great band of garnetiferous quartz-biotite gneiss which extends northeastward 30 or 40 miles is the complementary structure on the northwest limb of the large Somerville anticline, whose axis lies southwest of Halls Corners west of Antwerp. The core of the Sherman Lake syncline, which plunges southwest and is overturned toward the southeast, is a coarse porphyritic granite gneiss whose foliation is conformable to that in the enclosing garnetiferous quartz-biotite gneiss. The latter gneiss can be traced around the nose of the syncline but is cut off on the northwest side by the granite gneiss which comes against the overlying marble.

The Gold Hill deposit lies between the granite gneiss and the garnetiferous quartz-biotite gneiss on the southeast limb of the syncline. The Gold Hill vein starts to swing around the nose of the syncline but pinches out short of the axis, where the granite gneiss may be seen in direct contact with the garnetiferous quartz-biotite gneiss.

The Oxbow Southwest vein, or veins, lies in a rusty gneiss band within the marble on the northwest limb of the syncline. The veins of the Gold Hill and Oxbow Southwest prospects are at different stratigraphic horizons. Hence, it is clear that they are discontinuous and do not follow around the nose of the syncline to form a single zone of sulfide mineralization which might be tested by diamond drilling.

Gold Hill Prospect

The Gold Hill prospect (formerly referred to as the Laidlaw vein) is in Jefferson County, Town of Antwerp, Hammond quadrangle, about one mile southeast of Oxbow hamlet. (See geologic map, plate 17.) Principal outcrops are located on a conspicuous rusty-colored hill (Gold Hill) about 60 feet high lying about 900 feet southwest of the Oxbow-Antwerp road. (See plate 6A.)

The Gold Hill vein crops out more or less continuously for a distance of about 700 feet along the hill. It is difficult to determine the true thickness of the sulfide veins because the structural planes are not well defined, and wash from the gossan has obscured much of the bedrock. An outcrop width of 70 feet of vein material having an approximate average strike of N. 15° E. and a northwest dip of 35° was measured on the south end of Gold Hill. In an old pit on the

south end of the hill about three feet of sheeted pyrite ore are exposed with neither foot wall nor hanging wall in evidence. Stratigraphically below this is a covered zone about 10 feet wide covered by ferruginous till and eroded gossan from higher on the hill. Below this is a well-exposed 15-foot width of sheeted pyrrhotite underlain by a high grade pyrite vein about 50 feet wide in outcrop. There are some indications that the lower pyrite zone flattens somewhat down dip. Analyses of channel samples indicate a tenor of 35.6 percent sulfur for the lower pyrite band and 24.1 percent sulfur for the pyrrhotite part.

The foot wall of the rusty gneiss zone in which the sulfide mineralization occurs is a garnetiferous quartz-feldspar-biotite gneiss, but the hanging wall is not exposed. A narrow valley 350 feet wide and entirely devoid of outcrops lies between the exposed part of the vein and a precipitous cliff of gneissic granite on the west. The foot wall garnetiferous quartz-biotite gneiss is several hundred feet thick and is underlain by a thick belt of marble. About 2,000 feet south-southeast of Gold Hill another vein of pyrite is exposed in the creek bottom close to the contact of the garnetiferous gneiss and the marble. This vein is in a lens of rusty gneiss and is about seven feet thick. It can be traced along the strike for only about 30 feet because of the lack of outcrops.

Toward the north end of Gold Hill the dip of the rusty gneiss and associated rocks flattens considerably. Northward the belt of gneiss swings rapidly to the west, thinning considerably as it curves around the north end of the synclinal gneissic granite mass south of Oxbow. It is ultimately cut out completely by the granite, which comes into contact with the marble. North of Gold Hill no rusty gneiss or associated sulfide veins are exposed, and it is believed that the ore zones pinch out rapidly to the north of the outcrop areas.

South of Gold Hill is a covered area about 1,000 feet long in which there is no surface indication of the absence or presence of sulfide mineralization. Beyond that, outcrops of the garnetiferous gneiss are spottily distributed. No rusty gneiss crops out to the south along the projected strike of that exposed in Gold Hill.

About 1,500 feet southwest of Gold Hill, in immediate contact with the gneissic granite to the west, is a small outcrop of rusty gneiss that is highly graphitic and chloritic and has a pronounced schistosity. It is but slightly pyritic, although it has the characteristic rusty color of the more heavily mineralized gneisses. It is considered to be similar to certain phases of the rusty gneiss exposed in Gold Hill. Although this rusty gneiss appears to be cut off by the gneissic granite there is no conclusive evidence of a fault contact. Substantiating this view

is the absence of drag in either formation along the contact, the parallelism of the foliation in the two rock types, and the intercalation of several thin layers of gneissic granite in the rusty gneiss close to the contact.

Because of the strong magnetic attraction of the pyrrhotite occurring with the pyrite a dip-needle survey was made across the covered area to the south of the exposed veins. A strong, though intermittent, linear anomaly was recorded for about 1,000 feet south along the projected strike of the exposed pyrite-pyrrhotite vein. This anomaly indicates nothing specific with regard to the amount of mineralization, nor of the ratio of pyrite to pyrrhotite, but it does prove conclusively that some sort of mineralization involving a certain amount of pyrrhotite (and probably pyrite) does extend for at least 1,000 feet beyond the limit of the outcropping veins.

The trend of the anomaly recorded over the covered area south of Gold Hill angles across the trend of the formations as noted in outcrops, so that it is probable that the magnetic highs are determined by local concentrations of pyrrhotite arranged en echelon across the trend of the formations. If this is the case, there is a strong possibility that the narrow valley between Gold Hill and the gneissic granite cliff is underlain by rusty gneiss possessing variable sulfide mineralization.

It is 5½ miles from Gold Hill to the nearest point on the railroad at Keene, and about 6 miles to the railroad at Antwerp, by macadam and gravel surfaced roads.

Except during periods of excessive drought, an adequate water supply for exploratory drilling is available in the creek which runs along the east side of Gold Hill within a maximum distance of 800 feet from probable drill sites.

Oxbow Southwest Prospect

This deposit (formerly called the Frank Bent Farm prospect) is in Jefferson County about two miles southwest of Oxbow hamlet, Town of Antwerp, Hammond quadrangle, about 1,200 feet southeast of the "Pulpit Rock" road. There are two principal exposures of pyrite here. The northern exposure is visible from the road as rusty-brown, low-lying outcrops and extends southwest about 1,500 feet. It is separated from the southern exposure by an interval of about half a mile in which the pyrite either does not exist or is covered by glacial drift and outliers of Potsdam sandstone.

The northern pyrite vein occurs within a rusty gneiss band 50 to 175 feet wide intercalated with Grenville marble. Here the rusty gneiss strikes 35° to 45° northeast and dips 50° to 75° northwest. The pyrite vein within the rusty gneiss is only 8 to 10 feet wide. The pyrite in the vein is a nodular, disseminated type with thin, discontinuous lenses and stringers of high grade material alternating with more sparsely disseminated zones. The nodular texture promotes severe crumbling of the ore upon weathering. The gangue contains considerable quartz and a little disseminated chlorite and graphite. A channel sample cut across part of the vein analyzed 20.2 percent sulfur.

Outcrops of the southern part of the Oxbow Southwest belt occur about 1,200 feet southeast of the "Pulpit Rock" road bridge over the Vrooman Creek tributary. The principal outcrop lies on the southeast side of a small hill underlain by Grenville marble and a hematitic chlorite schist capped by Potsdam sandstone. The sandstone dips 15° to 25° to the east toward a narrow northeast-trending limestone valley into which it has slumped. The southeast wall of the valley is a precipitous cliff of granite gneiss and abruptly limits the possible loci of pyrite mineralization. A series of six or seven prospect holes have been dug in the hematitic schist along the west side of the narrow valley, but apparently no mining of the iron was ever attempted.

About 85 feet of rusty gneiss extends out from beneath the Potsdam cover and can be traced intermittently northeastward into the limestone valley for a total distance of 450 feet. Neither the top nor the bottom of the rusty gneiss is exposed. On the south end where the rusty gneiss passes under Potsdam sandstone on the west side the strike is N. 80° W. and the dip is vertical. The gneiss is severely crumpled into sharp chevron-like folds that involve the ore zones as well as barren rusty gneiss. The highly pyritic ore zone lies in the central part of the exposed rusty gneiss and is about 25 feet thick. With the exception of a zone about 10 feet thick, in which the pyrite is coarsely nodular and disseminated in a chloritic matrix, the ore zone is sheeted with alternating layers of rich and lean pyrite mineralization ranging in thickness from one-eighth inch to one inch. The pyrite in the sheeted zone is fine grained and is devoid of any nodular texture. In the sheeted ore the intense plications are especially marked. (See plate 6B.) In the hanging wall the transition from pyrite vein to relatively barren rusty gneiss is gradual, but in the foot wall it is very abrupt. Fifteen feet of barren rusty gneiss are exposed in the foot wall, and about 20 feet are exposed in the hanging wall.

In the limestone valley the strike of the pyrite vein and its enclosing rusty gneiss swings around to N. 45° E. and dips 55° northwest.

There are many local variations in this, however, though the rusty gneiss band in general probably parallels the regional northeast trend. Here a vein thickness of only 3 or 4 feet is exposed, but spotty outcrop distribution makes it impossible to determine total thickness. The ore exposed in the valley is devoid of sheeted structure. The pyrite is irregularly disseminated with pronounced nodular development locally.

Two channel samples cut across the pyritic sheeted zone analyzed 29.4 percent sulfur and 29.6 percent sulfur. This is considerably higher than the lower-grade mineralization sampled a half mile northeast.

Whether or not the northern and southern parts of the Oxbow Southwest belt are one and the same or separate veins is impossible to say without subsurface data. Casual field observation suggests that the southern mineralized zone lies stratigraphically below (?) the northern zone, with a hematitic schist formation intercalated between them. However in a prospect pit about midway between the two exposures of pyrite the hematitic schist is seen to strike N. 25° W. and dip 38° northeast. If this trend were carried far enough to the west before curving around to the regional northeast strike, the northern pyritic zone could well be in the same relative stratigraphic position as the southern zone. The cross-structure observed in the prospect pit suggests the possibility of the two ore zones lying on opposed limbs of an elongate sigmoid flexure having reversal of dip in the central part.

These deposits are not well located with respect to rail transportation. It is five miles by dirt and macadam road to the nearest railroad, at Antwerp. Although the deposits are very accessible by road, existing facilities are not adequate for heavy trucking.

An ample supply of water for drilling purposes is readily obtainable in Sherman Lake, which is less than 1,500 feet from the northern pyrite exposure. Seasonally, Vrooman Creek tributary could also supply ample water for drilling.

Antwerp-Keene Belt

The Antwerp-Keene is the longest belt of contiguous deposits in the entire region. It includes the Dickson, Wight, Morgan, Keene and Caledonia prospects, which are spread out along a five-mile belt extending northeast from the Dickson prospect about one mile north of Antwerp. The pyrite is closely associated with the hematite deposits of this belt, which according to Buddington (1934, p. 195) produced around 2,500,000 tons of ore between 1812 and the closing of the last working mine in 1910.

The ore zones occur in pyritic schists which principally underlie the hematitic gneisses in which the former iron mines were worked, but locally pyritic bands are intercalated with the iron-bearing horizons. The formations strike northeast and dip toward the northwest. The individual prospects are in all cases separated by covered areas overlain by glacial drift or Potsdam sandstone, but it is highly probable that the zone of sulfide mineralization is essentially continuous from one end of the belt to the other. The mineralized zone is believed to consist of a series of greatly elongate lenses of pyritic rock which maintain the same approximate, though not precise, stratigraphic position throughout. The zone of potential ore production lies within a few hundred feet of the base of the overlying marble and above the prominent belt of ridge-making garnetiferous quartz-biotite gneiss on the southeast.

The Dickson prospect on the southwest end of the Antwerp-Keene belt is separated from the Wight prospect to the northeast by 2,000 feet of flat meadows and cultivated fields. Projections of the strike of the veins at the two prospects indicate that they occur on the same trend line. Nothing exposed at the two localities suggests a thinning or pinching out of the pyrite veins under the intervening covered area. Thickness of overburden in the covered area is not known, but probably it is not too great. Two or three diamond drill holes 500 feet long should suffice to check the probability of sulfide mineralization persisting beneath the covered area.

Between the Wight prospect and the Morgan prospect, 1½ miles to the northeast, the zone of probable pyrite mineralization is buried by Potsdam sandstone and alluvium. At the Old Sterling iron mines, half a mile northeast of the Wight prospect, drilling by the Republic Steel Corporation proved the occurrence of pyritic schist at that place, although none is exposed in mine pits or outcrops.

Meadows cover the zone of probable pyrite mineralization between the Morgan prospect and the Keene prospect half a mile to the northeast. And between the Keene and Caledonia prospects, the pyritic zone is largely covered by Potsdam sandstone outliers.

The possibility of large tonnages of relatively high grade pyrite ore in the long zone of probably continuous sulfide mineralization makes the Antwerp-Keene belt particularly promising for diamond drilling exploration. The simple isoclinal structure of the belt and its ready accessability assure the effectiveness of even a limited drilling program. All of the prospects are ideally situated with respect to rail and highway transportation.

DICKSON-WIGHT PROSPECTS

The Dickson and Wight prospects are in Jefferson County, Town of Antwerp, Antwerp quadrangle, 1½ to 2 miles north of Antwerp village, southeast of U. S. Highway 11. (See geologic map, plate 15.) The Dickson prospect is the more southerly of the two and is separated by a covered zone from the Wight prospect, which lies about 2,000 feet north-northeast along the strike. (See plate 7A.) These two prospects occur at the southern end of the Antwerp-Keene belt of hematite deposits, which were worked in a small way many years ago. Both the Wight and Dickson properties were formerly prospected for hematite, which occurs in lenses within a hematitic quartz-chlorite gneiss closely associated with pyritic rusty gneisses. The Wight property apparently never produced any significant amount of ore, but the Dickson property did yield a considerable amount of hematite. According to Newland (1921, p. 129) the Dickson property was first worked in 1858 and for a few years following 1905. Except for several small pits on the pyrite at the Wight prospect, there is no indication that any attempt has ever been made to work either of the properties for pyrite.

The pyritic zone of the Dickson-Wight prospects lies above a ridge-making garnetiferous quartz-biotite gneiss on the east and below a belt of Grenville marble on the west. The low-lying pyritic zone is largely covered, so that contacts with the overlying marble and underlying gneiss are not exposed. Maximum possible width of the pyritic zone is about 1,000 feet, and it appears that the known pyrite veins lie within a few hundred feet stratigraphically below the marble. On the west the marble is largely cut out by a coarse pink gneissic granite of the Hermon type. Small caplike outliers of Potsdam sandstone are abundant west of the garnetiferous quartz-biotite gneiss.

The pyrite veins of the pyritic zone occur in typical rusty gneiss. Occurring stratigraphically above and below the known rusty gneiss bands is a dark red, schistose hematitic quartz-chlorite rock in which the former hematite ores occurred as pockets and lenses. It is probable that these hematitic schists represent former rusty gneiss bands largely replaced by hematite derived by oxidation of the pyrite (cf. Buddington, 1934, p. 201).

Dickson. This property lies along the abandoned bed of the old Jefferson Iron Company's spur track and can readily be reached by driving along the old railroad bed from where it crosses the farm road which extends east from U. S. Highway 11, about one mile north of Antwerp village. The old hematite workings are now flooded and generally inaccessible.

Outcrops of pyritic rock are not abundant here but a considerable amount of possible ore can be inferred. The principal showing of pyrite occurs on the east side of the abandoned railroad spur about 400 feet south of the large flooded open pit hematite workings. At this locality a flat-lying outcrop 40 feet wide of relatively-rich, coarse granular pyrite vein is exposed for about 240 feet along the strike. The dip of the vein is only about 20° to the northwest, which indicates a minimum vein thickness of about 15 feet. (See plate 7B.) Neither the foot wall nor the hanging wall of the vein is exposed, but it is overlain by hematitic quartz-chlorite schist and locally by hematite ore. A 27-foot channel sample cut across this outcrop analyzed 24.8 percent sulfur. About 350 feet northeast of this outcrop a small patch of similar pyritic rock is exposed on the west side of a low ridge of quartz-chlorite schist and hematitic gneiss. It is not known for certain whether the two pyrite outcrops are on a single band of rusty gneiss or not, but it is probable that they are not.

About 800 feet south of the first-mentioned pyrite outcrop is another exposure lying 30 feet east of the old railroad bed. A vein of pyrite showing a thickness of about five feet, with neither hanging wall nor foot wall exposed, strikes N. 30° E. and dips 25° northwest at this point. It seems probable that this is a continuation of one or both of the northern pyrite veins previously mentioned, but subsurface data are necessary to certify the point.

Five hundred feet north of the above vein outcrop, about 100 feet west of the abandoned railroad bed and hidden in a patch of woods, is a shallow prospect pit dug into hematitic quartz-chlorite schist. Lying conformably below the schist is a three-foot band of pyrite ore apparently of high grade. The pyrite vein locally is highly graphitic and gray in color. The ore is coarse-grained, disseminated and remarkably friable. Underlying the vein is a dark green graphitic chlorite schist with fine-grained sparsely disseminated pyrite. The pyrite vein and the enclosing beds strike N. 35° E. and dip 42° northwest. It is apparent that this pyrite vein is a different one from any of the others exposed in nearby outcrops. It should be noted that the prospect pit in which the pyrite vein is exposed normally is partially flooded, and the pyrite vein is likely to be above the water level only during a spell of dry weather.

Wight. This property lies two miles north of Antwerp village. It is about 1,800 feet southeast of U. S. Highway 11 and about 400 feet west of the abandoned spur railroad bed.

The pyrite vein occurs within a band of rusty gneiss which forms a low hill about 30 feet high and 1,200 feet long. The characteristic

PLATE 7

A. View looking northeast along strike from the Dickson prospect toward the Wight prospect, which is on the low ridge in the middle distance. The pyrite veins exposed at the two prospects are probably continuous beneath the intervening covered area. The ridge in the right background is garnetiferous quartz-biotite gneiss.

B. Pavement outcrop of coarse granular pyrite vein at Dickson prospect. The vein dips to the right at about 20 degrees.

Plate 8

A. Coarse nodular pyrite ore exposed in shallow pit at Wight prospect

B. Pyrite vein exposed in shallow trench at the Morgan prospect. The vein dips away from the observer at an angle of 30 degrees.

rusty brown color of the weathered outcrops makes the hill conspicuous when viewed from a distance.

The best showing of ore is about 400 feet northeastward along the strike from the south end of the hill. Here, in a shallow prospect pit, about 20 feet of pyrite ore are exposed striking N. 20° E. and dipping 50° northwest. A 25-foot channel sample cut across the vein here analyzed 30.9 percent sulfur. The continuity of the vein can be traced for about 350 feet toward the south by several small prospect pits. The ore is coarse-grained and conspicuously nodular. (See plate 8A.) Nodules of pyrite up to several inches in diameter are abundantly disseminated in a finer pyritic matrix containing irregularly distributed, though abundant, quartz and chlorite with lesser amounts of feldspar and graphite. Small lenses and knots of quartz-rich pegmatite are common. The ore is over- and underlain by a hematitic quartz-chlorite schist which has been prospected for iron to a small extent.

Toward the north end of the hill the band of pyritic rusty gneiss widens to a total thickness of about 275 feet. On the northeastern extremity of the hill the strike of the pyritic gneiss swings around abruptly to the northwest accompanied by a reversal of dip to the northeast. This suggests that some of the apparent thickening of the pyritic gneiss on the north end may be the result of the gneiss folding back on itself.

The entire width of rusty gneiss outcropping toward the north end of the hill is unusually high in disseminated pyrite and might constitute ore. In a rough way the band of gneiss is sheeted, with high grade pyrite zones alternating with leaner rock. Maximum development of pyrite mineralization is found in a 20-foot vein outcropping along the crest of the hill.

Along the east side of the hill in the northern part is a 40-foot band of a garnet-pyroxene gneiss lying between the pyritic rusty gneiss above and a hematitic quartz-chlorite gneiss below. Toward the south end of the hill a 75-foot pegmatite dike lies between the pyritic rusty gneiss and the hematitic quartz-chlorite gneiss.

Both the Wight and the Dickson properties are well situated with respect to rail transportation. The Wight prospect is only 1½ miles to the railroad by way of the abandoned spur, and the Dickson is even closer. Abundant water for drilling the properties is available in the spring-fed flooded hematite pit on the Dickson property and in a similar pit at the Old Sterling property about 3,000 feet northeast of the Wight prospect.

MORGAN PROSPECT

The Morgan prospect is located in Jefferson County, Town of Antwerp, Antwerp quadrangle, about 3¼ miles northeast of the village of Antwerp. The deposit lies on the west side of the dirt road 1½ miles southwest of Keene's Station, and about 2,000 feet north of the bridge over Hawkins Creek.

This locality was originally prospected for hematite, and an old open pit mine, now flooded, lies to the west of the pyrite exposures. The hematite occurs in chloritic schists which are partially overlain by Cambrian Potsdam sandstone.

The pyrite vein occurs in a rusty gneiss underlying the hematitic chloritic schists. A thickness of about 15 feet of rusty gneiss is exposed in a shallow trench 50 feet long lying about 75 feet west of the road. (See plate 8B.) The pyrite vein comprises the upper eight feet of the rusty gneiss, which strikes N. 45° E. and dips 30° northwest. Diamond drill logs made available to the writer by Republic Steel Corporation indicate a minimum thickness of 75 feet of rusty gneiss underlying the old hematite mine.

The pyrite ore is somewhat nodular and weathers to irregular pitted surfaces. Abundant reticulating stringers and disseminated grains of pyrite occur in a chloritic groundmass with a little flaky graphite. A six-foot channel sample cut across the pyrite vein analyzed 23.5 percent sulfur.

The Morgan prospect is 2½ miles from the railroad at Keene's Station by dirt and macadam roads, but only half a mile airline northwest of the railroad southwest of Keene's Station. Water for drilling purposes would be available seasonally in the water-filled hematite pit about 300 feet northwest of the trench on the pyrite vein. A more dependable supply of drilling water can be obtained from Hawkins Creek, about 1,700 feet east of the prospect.

KEENE PROSPECT

The Keene prospect is in Jefferson County, Town of Antwerp, Hammond quadrangle. It is located in the immediate vicinity of the old Keene Ore Bed hematite mine half a mile southwest of Keene's Station and four-fifths of a mile west of Spragueville.

Outcrops of the rusty gneiss and pyrite vein lie in open pasture on top of the knoll north of the farmhouse at the dirt roads intersection three-fifths of a mile southwest of Keene's Station.

The rusty gneiss, a typical pyritic quartz-chlorite gneiss, can be followed along the strike for about 300 feet with a maximum width of 110 feet. It strikes N. 65° E. and dips 35° northwest. To the

southwest the gneiss passes under meadow; to the northeast it passes under a capping of Potsdam sandstone beneath which the hematite deposits lie.

The pyrite vein occurs toward the lower part of the rusty gneiss and is at least 12 feet wide, although neither hanging wall nor foot wall are exposed. The vein material consists of coarse nodular pyrite in a dark green quartz-chlorite matrix. A 4½-foot channel sample cut across the vein analyzed 29.3 percent sulfur.

Conformably underlying the rusty gneiss is a hematitic quartz chlorite schist about 100 feet thick, which is underlain by a thick garnetiferous quartz-biotite-oligoclase gneiss containing abundant pegmatite layers.

Water for drilling purposes is available in Matoon Creek, about 1,000 feet north of the pyrite outcrops. The prospect is only half a mile by dirt road to railroad facilities at Keene's Station, and less than 1,000 feet to the nearest point on the railroad.

CALEDONIA PROSPECT

The Caledonia mines are located in St. Lawrence County, Town of Rossie, Hammond quadrangle, at abandoned Old Iron Works, about 1.2 miles southeast of Somerville.

The Caledonia mines were formerly worked for hematite, but the association of pyrite with the iron ores has never been of economic importance. Surface indications of pyrite are very meager, but those few, plus data collected in a recent (1948) program of diamond drilling of the hematite deposits by Republic Steel Corporation, indicate that the entire hematite area is underlain by one or more layers of pyritic schist. Although there are horizons approaching a possible ore tenor of pyrite, the schist layers on the whole are too lean to be of economic grade.

The pyrite occurs in a thick graphitic quartz-chlorite schist which is strongly laminated and alternately marked by layers relatively rich in chlorite, graphite, quartz or pyrite, and occasionally hematite which apparently resulted from the oxidation of the pyrite. The pyritic layers characteristically are less than an inch wide but may be closely spaced so that zones tens of feet thick may be as much as 30 percent pyrite by volume. Locally the pyrite bands enlarge and run together to make more massive concentrations.

A vertical drill hole put down to a depth of 549 feet in the central part of the mines area cut almost 200 feet of a pyritic and graphitic quartz-chlorite schist averaging about 30 percent pyrite by volume. Chemical analyses have not been made of the pyritic schist, but it is

believed that the schist would average at best something less than 20 percent sulfur—probably close to 15 percent.

The pyritic and graphitic quartz-chlorite schist is underlain by an impure marble with variable distribution of serpentine, phlogopite, disseminated pyrite and pockets and layers of hematite. The schist and the marble are deformed into small open folds and are capped locally by outliers of Cambrian Potsdam sandstone.

A few hundred feet southwest of the large Caledonia open pit, now water-filled, is an adit driven north into a hematitic quartz-chlorite schist. Here about 10 feet of thinly-sheeted pyritic gneiss underlie the hematitic rock. About 200 feet farther southwest, in a small water-filled pit, 7 feet of thinly-sheeted graphitic and chloritic pyrite gneiss underlie about 5 feet of flaggy hematitic gneiss. (See plate 9A.) Here the formations are very flat-lying, with a north-south strike and a 5°-10° dip northwest. Other surface exposures of the pyritic gneiss lie along the abandoned road 600-900 feet east of the former road intersection at Old Iron Works. In this area the pyritic gneiss strikes N. 40° E. and dips 45°-50° northwest. On the north side of the abandoned road, about 930 feet east of the old intersection, about 6 feet of a thinly-sheeted pyritic gneiss underlie a hematitic quartz-chlorite schist. The rocks strike N. 50° E. and dip steeply northwest. The sheeting of the pyritic gneiss consists of veinlets of pyrite one-half inch thick alternating with graphitic quartz-chlorite layers of similar thickness.

The Caledonia workings are excellently situated with respect to transportation as they lie within a few hundred yards of the railroad and are circumscribed by the bedding of an old railroad spur, now abandoned. Water for drilling purposes is in adequate supply in the large flooded Caledonia open pit.

Bigelow Belt

The Bigelow belt is marked by five prospects, the Cole, Hendricks, Stiles, Mitchell and Farr, which occur along the narrow mineralized zone extending northeast from the old Cole mine through Richville Station (Bigelow) and on to the Farr shaft, a total length of about 6½ miles.

Geologically the Bigelow belt consists of a band of quartz-biotite gneiss averaging 500-1,000 feet in width for most of its extent but thinning abruptly on both ends, and over- and underlain by bands of Grenville marble. The trend of the belt is northeasterly with prevailing dips 40°-70° northwest in conformity with the regional structure. The quartz-biotite gneiss is the northeastern extension of the garnetiferous quartz-biotite gneiss of the Oxbow and Antwerp-Keene belts.

PLATE 9

A. Pyritic rusty gneiss underlying flaggy hematitic gneiss in small pit about 500 feet southwest of the large open pit hematite mine at the Caledonia prospect. The contact between the two formations is at the conspicuous break one-third of the way down from the top of the exposed section.

B. Pyrite veins exposed at entrance to old shaft at the Cole mine

The pyrite deposits occur in typical pyritic and chloritic rusty gneisses. In at least three of the deposits pyrrhotite occurs with the pyrite. Two of the deposits, the Stiles and the Farr, immediately underlie the hanging wall marble. The Cole mine is in approximately the same stratigraphic position, although because of local deviation from the regional structure the "hanging wall" marble here underlies the veins. The Hendricks and Mitchell prospects occur in the gneiss just above the foot wall marble.

It is clear that the deposits of the Bigelow belt are not all on the same vein. This fact would make prospecting by diamond drill in the intervening covered areas largely guesswork, although the possibility must be entertained that mineralized zones having no surface expression lie beneath the covered areas. The approximate contact of the gneiss and the marbles between the Cole and Hendricks prospects are marked by small streams but elsewhere in the belt the approximate contacts are less certainly known.

The Cole prospect on the southwest end of the belt is separated from the Hendricks prospect to the northeast by 1½ miles of covered fields, and the 3 miles intervening between the Hendricks and Stiles prospects is similarly covered in large part.

COLE PROSPECT

This prospect is in St. Lawrence County, Town of Gouverneur, Gouverneur quadrangle. The abandoned mine workings are along the New York Central Railroad tracks about 5 miles northeast of Gouverneur village, and 1½ miles south of Richville.

The Cole mine was operated intermittently prior to 1921, and in its lifetime probably produced around 100,000 long tons of pyrite ore averaging 25 percent sulfur. The operation was begun as an open pit but ultimately went underground with workings several hundred feet deep.

Buddington (1917, p. 31) presented the following data given by W. J. Bulger of Gouverneur:

"The shaft was sunk 225 feet on the ore at an angle of 26 degrees parallel to the railroad which is here NE., making the strike NW., a very unusual phenomenon for this district. The ore on which the shaft is sunk ran from 15-18 feet in thickness. A second body of ore was struck by cross-cutting to the northeast for about 15 feet through the gneiss. A drift was run through this body for 90 feet parallel to the railroad while a drift at right angles to this was cut through ore for 60 feet, coming against limestone on the northwest and gneiss on the southeast. The vein on which the shaft is sunk and this over-

lying ore body were found to be connected by about 10 feet of ore on the northwest side. The ore here has evidently been folded together with the gneiss subsequent to its formation and the apparent size of the upper vein is probably due to the flat lying position."

In the portal of the more southerly of two remaining shaft openings four distinct pyrite veins separated by thinner bands of relatively nonpyritic rusty chloritic schist are evident. (See plate 9B.) Aggregate vein thickness exposed is in excess of 16 feet separated by three barren schist zones totalling less than 4 feet in thickness. Neither the hanging wall of the uppermost vein nor the foot wall of the lowermost vein is exposed. The veins and intervening rock strike N. 45° W. and dip about 30° northeast. This local overturning to the northwest is anomalous to the regional structure and accounts for the apparent interchange of hanging wall and foot wall formations at this place. The uppermost vein forms the hanging wall of the inclined shaft, which parallels the dips of the veins.

The coarse pyrite in the veins is irregularly distributed in knots, clumps, stringers and lenses. The pyrite occurs in a dark green chloritic groundmass which contains abundant disseminated flakes of graphite, in addition to quartz and feldspar. Knots of pyrite up to six inches in diameter are abundant.

The relatively barren schist intervening between the ore veins contains only a little finely disseminated pyrite. This rock is fine-grained and weathers to a yellowish-brown color having a noticeable greenish cast, which is in strong contrast to the dark green color of the veins. Contacts between veins and the interlayered barren rock are sharp.

With the exception of the uppermost vein, which seems to run a little lower in sulfur, all of the veins appear to have about the same tenor. A channel sample cut across the second vein from the top analyzed 29.3 percent sulfur. An analysis of concentrates collected from an open pile near the old mill indicates 36.5 percent sulfur. Oxidation and leaching of this material exposed to the weather for about 30 years undoubtedly has lowered the sulfur content somewhat.

Rock outcrops are scarce in the immediate vicinity of the old Cole mine. Pyrite ore is exposed at the south shaft and in a few prospect pits a few hundred feet to the southeast. On the west side of the flooded pit alongside the railroad track and close to the road pyritic schist crops out. The foliation strikes N. 10° W. and dips 40° east. Strong axial lineation plunges 35° N. 50° E. This pyritic and chloritic rock is underlain by a quartz rock having a spongy texture and containing abundant disseminated graphite and a little pyrite. On the

PLATE 10

Vein of nodular pyrite ore within sheeted rusty gneiss in shallow prospect pit at the Hendricks prospect. The hammer is at the footwall contact of the vein.

east side of the pit is an outcrop of pyrite ore. The ore is rather coarse-grained with the pyrite aggregated into conspicuous knots and stringers in a chloritic and graphitic groundmass. There is a strong tendency toward euhedral development of the pyrite. The structure of the vein here is not clear. There are some indications, however, that the strike is about north, with a variable dip to the east.

A small marble outcrop lies N. 70° W. of the south shaft, about halfway between the shaft and the railroad. The foliation in the marble strikes N. 15° E. and dips 60° SE.

A thin-bedded quartzite flooded with a good deal of massive white quartz crops out in the pasture about 2,000 feet southwest of the shaft. The quartzite is strongly deformed with a marked development of northwest structural trends. Near an old quarry at this place there is a tight synclinal fold plunging gently toward the southeast. The axis of the fold strikes about N. 60° W. The meager data available in outcrops and excavations indicate that in the vicinity of the Cole mine the structure of the Grenville formations is at variance with the regional northeast trends.

The Cole prospect is ideally located with respect to rail transportation as it is right alongside the railroad. Water for drilling is available in the flooded open pit close to the railroad tracks.

HENDRICKS PROSPECT

The Hendricks prospect is in St. Lawrence County, Town of DeKalb, Gouverneur quadrangle. It is about a mile south of Richville and 1½ miles southwest of Richville Station (Bigelow). The abandoned shaft is on the west side of the New York Central Railroad where the track crosses Boland Creek. The old Cole mine lies 1½ miles to the southwest.

The pyrite vein occurs in a thin band of rusty gneiss which crosses the creek about 30 feet downstream from the aqueduct under the railroad tracks. A thickness of about 25 feet of rusty gneiss is exposed in the creek bottom and along the bank. The rusty gneiss strikes N. 35° E. and dips 65° northwest. The gneiss is a graphitic quartz-chlorite gneiss with abundant disseminated pyrite and is sheeted with fine-grained quartz-pyrite veinlets less than one inch thick. These quartz-pyrite veinlets constitute 10-15 percent of the rock by volume.

The principal vein is well-exposed on the southwest bank of the stream about 15 feet back from the water in what appears to be a shallow prospect pit. (See plate 10.) Here the vein is about three feet wide. It is nodular and lacks the sheeted structure of the enclosing rusty gneiss. Nodules of pyrite crystals half an inch to 1½ inches in

diameter are abundant and occur in a finer, dark green matrix of pyrite, quartz, chlorite and some graphite. A three-foot channel sample cut across the vein analyzed 26.9 percent sulfur. The foot wall contact is gradational. The vein occurs in the lower half of the rusty gneiss and lies about 12 feet stratigraphically above the contact of the rusty gneiss and the underlying marble formation.

Fifty feet from the creek southwest along the strike of the vein is an old shaft which is reported to have been sunk in 1904 to a depth of 50 feet and then abandoned. It is now largely filled with trash and partially flooded. Here the gneiss strikes N. 35° E. and dips 75° northwest. The excavation is largely in the hanging wall sheeted zone. Only about 1½ feet of the vein are exposed in the east corner of the shaft; the rest presumably is covered by slumped material and trash.

A lens of pegmatite bearing black tourmaline outcrops on the slope about 15 feet west of the shaft, but its true size and shape are obscured by debris.

The vein can be traced several hundred feet northeast along the strike to the base of the railroad embankment. Former pits and trenches along the strike are now filled or badly slumped so that little of the geology can be seen. Buddington (1917, p. 30) gave the following description:

"At the northern end, immediately beneath the railroad track, the vein widens to six feet. This ore vein is but a richer band lying in a pyritic zone which is well exposed in the bed of the brook where it is about ten feet thick.

"Here, limestone is exposed as the foot wall of the gneiss belt. It is overlain by 7-10 feet of chloritic gneiss with a fresh pegmatite vein from one to four feet thick at the base. The rich ore vein about two feet thick overlies this gneiss, and is in turn overlain by 0.8 foot of lean gneiss. This is succeeded by two pyritic sheeted zones each about two feet thick and each separated from each other by about 2½ feet of chloritic gneiss with only a rare thin layer of pyrite. In the sheeted zones the veins are from ¼ to 1 inch thick averaging about one-half inch and form from one-third to one-seventh of the total rock by volume. These thin layers or lenticular pockets are parallel to the foliation and consist of coarse granular pyrite. The lower sheeted zone might pass for lean ore but it is doubtful if the upper zone carries a sufficiently high percentage of sulfur or a convenient position to warrant mining."

Underlying the rusty gneiss in which the pyrite occurs is a coarse white marble containing abundant serpentinized diopside and a little tremolite. The contact between the marble and the rusty gneiss is well

exposed in the creek bottom just below the railroad. The marble can be followed for 150 feet southwest along the strike from the shaft.

The hanging wall gneiss is a highly micaceous muscovite-biotite-quartz-feldspar gneiss abundantly sheeted by thin layers of pegmatite. Graphite and pyrite are sparsely disseminated throughout. Several hundred feet downstream from the railroad the creek swings parallel to the strike of this gneiss, which is N. 35° E. with a 58° northwest dip.

The pyrite vein and its enclosing rusty gneiss cannot be followed along the projected strike farther than indicated above. To the northeast meadows cover the bedrock, and to the southwest there is an outcrop gap of several hundred feet between the foot wall marble and the hanging wall gneiss.

The Hendricks prospect is right next to the railroad and about 2¾ miles by dirt road to the railroad at Richville Station (Bigelow). An abundant supply of water for drilling purposes is available at all times in Boland Creek, which crosses the prospect.

STILES-MITCHELL-FARR PROSPECTS

The Stiles, Mitchell and Farr deposits are in St. Lawrence County, Town of DeKalb, Gouverneur quadrangle, about three miles northeast of Richville. (See geologic map, plate 16.) These deposits are situated near the margins and toward the northeast end of a belt of quartz-biotite gneiss which extends from the Farr prospect southwestward to the Cole mine, a distance of about 6½ miles. The three deposits are situated within 7,000 feet of each other and are about equally spaced along the trend of the belt. The pyrite concentrations occur in bands of typical rusty gneiss lying at the upper and lower contacts of the gneiss.

The quartz-biotite gneiss is underlain by a thick, coarse-grained calcareous marble and is overlain by highly silicated dolomitic marble. Above the upper marble is a thick zone of thinly laminated quartzite and silicated marble, with abundant intercalated zones of massive quartzite and zones of relatively pure marble. Below the lower marble is a large sheet of gneissic granite (Hermon type) prominently cropping out in Moss Ridge. All of the formations trend northeast conformably to the regional structure and dip northwest at angles ranging from about 25° to 80° or more. Average dips are around 45°-50°. In many places a prominent axial lineation plunges 35°-45° N. 10° E. (average). A few small scattered outliers of Potsdam sandstone cap the Precambrian rocks locally.

The Stiles and Farr deposits occur in rusty gneiss layers lying between the quartz-biotite gneiss and the upper, silicated marble.

The Mitchell deposit occurs in rusty gneiss lying between the quartz-biotite gneiss and the lower, calcareous marble. It is thus clear that the three deposits are not at the same stratigraphic horizon and certainly are not on the same vein.

Several feet of highly pyritic gneiss crop out in the right bank of Indian Creek in a lens of rusty gneiss intercalated with the calcareous marble.

Stiles. This deposit is situated about 1.8 miles northeast of Richville Station (Bigelow) near the conspicuous southwest-pointing elbow of Indian Creek. An inclined shaft was sunk into the bank above the creek at this point in 1904 and is reported to have extended to a depth of about 45 feet down the dip. The workings were abandoned after a few months and have not been activated since. The shaft is now flooded and partially filled so that only the portal is accessible.

About eight feet of pyritic schist are exposed in the portal walls. Immediately lower in the sequence another seven feet are exposed on the south side of the bank into which the shaft was sunk. The upper eight feet are the host highly pyritic and constitute the vein. Overlying the vein, and separating it from the hanging wall marble, are about five feet of a flaggy, rusty chloritic feldspathic gneiss. The vein and enclosing rusty gneisses strike N. 50° E. and dip 40° northwest.

The pyrite is abundantly disseminated throughout the vein but tends to become more concentrated into a series of irregular inch-scale veinlets that pinch and swell along the strike and down the dip. Conspicuous knots of pyrite occur along the axes of the abundant intense plications which are conspicuous in the vein. This flexure structure is accentuated by thin stringers of pegmatite interlayered with the pyritic schist of the vein. The flexures plunge 15° N. 22° E. By volume, less than half of the vein as exposed in the portal wall is comprised of ore layers, which alternate with slightly pyritic rusty schist and thin partings of chloritic gneiss. Five distinct veinlets up to four inches wide account for the bulk of the pyrite in the vein, although the intervening schist is also variably pyritic. A five-foot channel sample cut across the portal wall assayed 15.2 percent sulfur. On the surface the pyritic zone can be traced for only 15 feet along the strike because of lack of outcrops.

Mitchell. This deposit is located 2½ miles northeast of Richville Station (Bigelow) on a wooded low ridge on the north side of Indian Creek. It is about 4,000 feet east-northeast of the old Stiles shaft. A shaft was sunk here in the spring of 1904 and then abandoned. The old shaft is now partly filled in and flooded so that little of the geology can be studied.

A five-foot layer of coarse granular pyrite ore is exposed immediately above the foot wall in the shaft and is overlain by a one-foot sheeted zone in which veinlets of massive pyrite one to two inches thick alternate with barren gneiss bands of similar thickness. Overlying the principal vein 15 feet of hanging wall chloritic rusty gneiss are exposed. This gneiss is variably pyritic with irregular distribution of the sulfide in stringers, discontinuous lenses and disseminated grains. The band of pyrrhotite rock reported by Buddington (1917, p. 28) to overlie the pyrite vein was not seen although abundant pyrrhotite may be found on the dumps. The pyrite vein is conformable to the enclosing rusty gneiss, which strikes N. 65° E. and dips 60° northwest. A 3½-foot channel sample cut in the massive vein analyzed 28.3 percent sulfur.

The ore zone is well exposed in a shallow prospect trench lying about 32 feet northeast of the shaft along the strike of the mineralized zone. On the southwest side of the trench, which is about 25 feet long, part of the pyrite vein seen in the shaft is well exposed. Further northeastward along the strike no outcrops of the vein or rusty gneiss are present. Southwestward, however, the mineralized zone crops out intermittently along the strike for a distance of almost 1,000 feet. A strong local magnetic anomaly about 300 feet southwest along the strike from the shaft indicates the presence of pyrrhotite mineralization at that place. Several small prospect pits in the same vicinity prove the continuity of mineralization across covered areas.

Farr. This prospect is situated about three miles northeast of Richville Station (Bigelow) and lies about 2,000 feet northeast of the old Mitchell shaft. It is well hidden in a clump of trees about half a mile southeast of the abandoned schoolhouse on the road northeast out of Richville Station, and is about 675 feet north of tower No. 88 of the power transmission line which trends northeast-southwest north of Indian Creek.

As in the case of the Mitchell and Farr prospects, a shaft was started in the spring of 1904 and then abandoned. The shaft is now flooded to within 10 feet of the top so that it is quite inaccessible. The material on the dumps suggests that the excavation here probably exceeded in depth those of the other two prospects in the belt.

The rusty gneiss in which the sulfide veins occur here is at the same stratigraphic horizon as that of the Stiles deposit to the southwest, but the rusty gneiss is not continuous from one to the other. Between the Mitchell and Farr deposits the quartz biotite gneiss thins rapidly and appears to pinch out completely about 200 feet northeast of the

Farr shaft. This pinch-out brings the upper silicated marble and lower calcareous marble in contact with one another.

The rusty gneiss and associated marbles and quartz-biotite gneiss are much disturbed at and in the vicinity of the Farr shaft. Several sharp flexures in the formations are discernible, and a great thickening of the rusty gneiss to an inferred width of about 500 feet in ground plan indicates intense local folding.

A number of sharp asymmetrical drag folds are exposed in the upper part of the old shaft, and it appears that locally concentration of the sulfides may have been controlled by the folding. The ore attains maximum thickness along the axes of the anticlinal and synclinal drag folds. The principal fold is an asymmetrical anticline plunging gently N. 50° E. and overturned toward the southwest. The limbs of this fold are crenulated into a series of smaller anticlines and synclines. These structures trend diagonally across the shaft opening.

Because of the inaccessibility of the flooded shaft it is impossible to determine the true thickness of the veins or to delimit them accurately. The veins do not appear to be tabular bodies but rather are lenslike. At least six feet of pyrrhotite ore are exposed beneath a gentle synclinal fold on the northeast side of the shaft and are overlain by a few inches of pyrite. In the southwest corner of the shaft a steeply-dipping vein of coarse granular pyrite about two feet thick was channel-sampled and assayed 30.6 percent sulfur. This vein thins considerably over the highest point of the principal overturned anticline. A number of small lenses of pyrite ore occur along the arches and troughs of minor drag folds on the east limb of the principal anticline.

Just above the hanging wall of the shaft the sulfide veins and the enclosing rusty gneiss swing sharply around to the north. In an old prospect pit (now largely filled in) about 60 feet to the north, Buddington (1917, p. 27) reported an exposed thickness of nine feet of pyrrhotite ore. Just beyond this pit the rusty gneiss swings abruptly east and lenses out completely within 75 feet.

Hermon-Pyrites Belt

This belt is unified by a body of dark gneiss extending from the Stella mines north of Hermon northeast to the Pyrites (formerly High Falls) prospect along the Grass River in the hamlet of Pyrites. The dark gneiss, which varies from pyroxenic amphibolite to hornblende-biotite gneiss and quartz-biotite gneiss, has been interpreted by Martin (1916, pp. 61-62) and others as an intrusive gabbro subsequently metamorphosed and variably injected by granitic ma-

terial. The Stella mines on the southwest and the Pyrites mine on the northeast are in typical rusty gneiss bands enclosed in lenses of the dark gneisses. The two lenses are connected by a narrow neck of the dark gneisses 2½ miles long, which proves the co-identity of the dark gneiss antecedents. Toward the southwest end the initial rock has been so altered by granitic solutions that its consanguinity with the more gabbroic appearing rock on the northeast might not be suspected were it not for the continuity provided by the connecting neck.

Concerning the gabbro and its dark gneiss derivatives Martin (1916, pp. 61-62) had the following to say:

"That this dark gray to black, massive to gneissoid, coarsely crystalline rock is a true gabbro, can hardly be doubted, for abundant hypersthene and augite are found in several localities where it preserves a more massive aspect . . .

"On going westward and northward from . . . [the vicinity of Pyrites] . . . the rock assumes a gneissoid and finally a schistose structure, with a concomitant alteration of all its pyroxene into amphibole and liberation of free silica, and the production of hornblende schist or amphibolite. These altered equivalents of the gabbro-diorite may be traced continuously southwestward into the vicinity of the Stella pyrite mines, near Hermon . . .

"That the gabbro-diorite and its derived schists are intrusive into the Grenville and not the basement upon which these sediments were laid down is, moreover, conclusively demonstrated by the numerous xenoliths of limestone, quartzite, garnetiferous and pyritiferous gneiss scattered irregularly in the amphibolite between Pyrites village and Harrison Creek . . ."

The rusty gneiss band containing the Pyrites prospect appears to be a true xenolith broken from the Grenville country rock and engulfed in the invading magma. The rusty gneiss bands containing the Stella mines veins were injected parallel to their foliation by sheets of the gabbro magma but are not clearly true xenoliths wholly disrupted from the Grenville country rock.

STELLA PROSPECT

The Stella prospect is located in St. Lawrence County, Town of DeKalb, Russell quadrangle, about one mile north of the village of Hermon on State Highway 87. (See geologic map, plate 17.) During the active life of the mines the thriving hamlet of Stellaville was located here, but today little remains of the settlement.

The ore veins occur in typical rusty gneisses enclosed in a lens of metagabbro highly modified by granitic injections. The metagabbro

lithologically is biotitic amphibolite and quartz-hornblende-biotite gneiss, which would probably not be recognized as metagabbro were it not for the narrow neck connecting these rocks with the recognizable metagabbro at Pyrites to the northeast.

There are two principal ore zones separated by about 650 feet of ridge-making quartz-hornblende-biotite gneiss which is amphibolitic in the central part but grades laterally, and southwestward along the trend, into a granitic quartz-biotite gneiss. On the northeast the amphibolitic zone interfingers with at least two marble lenses cropping out along the highway. A large lenticular mass of similar amphibolitic gneiss underlies the lower ore zone. Overlying the upper ore zone are about 800 feet of migmatitic quartz-hornblende-biotite gneiss superposed by dolomitic and calcareous marbles of undetermined thickness. Within the upper quartz-hornblende-biotite zone is an infolded mass of dolomitic marble and associated quartz-diopside rock ("quartz mesh" rock) cropping out in an area about 800 x 400 feet. A gentle flexure affects all of the formations in the central part of the map area, where the regional northeast strike swings around to almost north, and then back to northeast once again.

The ore veins occur in sheets or lenses of typical chloritic rusty gneisses containing variable amounts of disseminated graphite. The ore consists of irregular reticulating veinlets of pyrite locally coalesced to form coarse knots or clusters of pyrite grains, and disseminated pyrite grains in a dark green graphitic and chloritic matrix. Pyrrhotite lenses and stringers occur sporadically throughout the veins, but always as discrete units without admixed pyrite.

The initial workings were on the upper vein, which was reached through the Stella shaft. It was actively worked from time to time until the financial failure of its owners in 1900, after which it remained idle. According to McDonald (1913, p. 690), ". . . . the ore body, averaging 10 feet thick, extends 1,100 feet along the strike and has been worked 900 feet down the dip of 20° to 30°; considerable pyrrhotite occurs in the ore."

The upper vein is still exposed in the collar of the Stella shaft, which is flooded and partially blocked by rotted timbers. A 12-foot thickness of coarse nodular vein material is exposed underlying typical rusty gneiss in the hanging wall of the vein. The shaft was sunk right on the vein, which here strikes N. 18° E. and dips 35° northwest. A prospect pit exposes the vein again 57 feet S. 35° W. of the shaft. Here the vein strikes N. 20° E. and dips 35° northwest. The rusty gneiss which enclosed the vein at the Stella shaft is exposed at the west foot of the rock dump near the shaft collar, and on the east

side of the abandoned railroad spur that ran directly in front of the shaft. The thickness of the rusty gneiss, including the vein, exposed at this place is about 70 feet.

Extensions of the vein and enclosing gneiss to the northeast are obscured by tailings from the mill. Outcrops of the pyritic rocks northwestward along the strike projection are lacking, but it is probable that they underlie the narrow valley which lies between ridges of granitic quartz-biotite gneiss.

The lower ore zone yielded the principal production from the property and consists of at least five separate veins. All of the veins in this zone were worked from the Anna shaft, which was close to the road and abandoned railroad about 1,600 feet southeast of the Stella shaft. The Anna shaft is now completely filled in.

McDonald (1913, p. 690) gave the following description of the Anna mine:

"The Anna shaft . . . is on a parallel lens about 1,000 feet in the footwall of the Stella mine; the ore averages 20 feet thick and has been followed 250 feet down at 45° dip and 1,200 feet along the strike. The walls are not sharply defined and the merchantable ore fades gradually into rusty gneiss. Following the general rule of the entire district, the deposits strike NE. and dip to the NW.

"The ore carries from 15 to 40% sulfur, with an average of about 21%. Practically all the mine output is concentrated; though a rather low-grade ore, it is free from arsenic and injurious impurities . . ."

Buddington (1917, p. 22) wrote that the ore ". . . occurs as a series of veins parallel to each other and to the foliation of the enclosing gneiss. There are four, perhaps five, such veins being worked from the single shaft at the present time. These are called the Z, A, B and C veins going from bottom to top. . . . Each of the four veins is from 75 to 100 feet above the other. The Z vein has a thickness of from 12 to 14 feet; the A and B veins each average about 18 feet thick, and the C vein is from 6 to 8 feet in width. The veins vary somewhat in thickness reaching a maximum of 40 feet locally on the A and B veins.

"The Anna shaft is sunk on the A vein and the workings are down to 600 feet. The veins have been developed along the strike for a length of 1,800 feet and have been proved by diamond drilling to extend much further."

Outcrops of the veins in the lower zone are spotty but suffice to mark the trend and spacing of the ore horizons. The uppermost vein of the lower zone, the C vein, lies in the draw just east of the ridge of quartz-hornblende-biotite gneiss which separates the upper and

lower ore zones. Toward the upper end of the draw, about 400 feet west of the Anna shaft waste rock dump, two prospect pits 100 feet apart have been opened on the vein. In the farthest one about four feet of ore are exposed striking N. 45° E. and dipping 38° northwest. The vein and enclosing rusty gneiss cross the highway to the northeast 200 feet north of the house on the east side of the road, opposite Hermon village dump, and crops out in a small patch on the east side of the road, and again in the west bank of Elm Creek about 300 feet downstream from the falls.

Directly behind the house mentioned above, and in the banks of Elm Creek directly below the falls, another band of rusty gneiss is exposed. This probably is related to the B vein, although two distinct pyrite horizons are not delimited in outcrop southwestward along the strike. It may be that the two separate bands east of the road indicate bifurcation of a single vein exposed in the two prospect pits mentioned above.

The A vein can be seen in the collar of an inclined shaft which is about 75 feet southwest of the Anna waste rock dump alongside the highway.

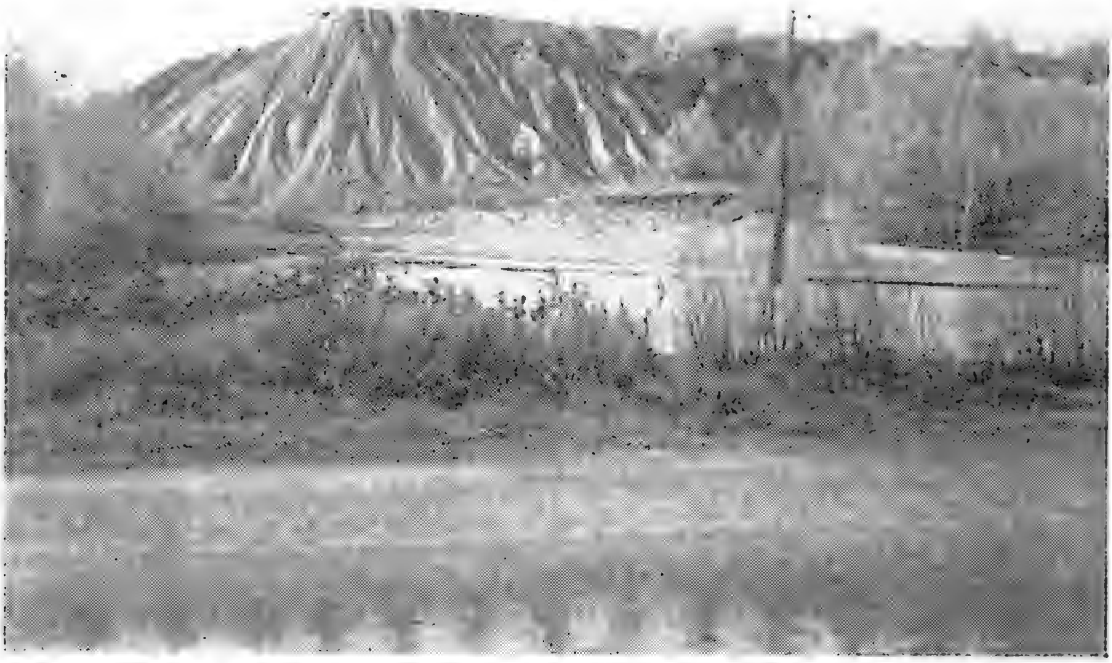
The strike here is N. 25° E., dip 30° northwest. The strike of the vein projected would carry it under the rock dump and on across the highway, where a round cave-in 100 feet across presumably marks the extension of mine workings along the trend of the vein. The Anna shaft is reported to have been along the abandoned railroad on the north side of the waste rock dump west of the highway, and thus would be directly on the vein.

The Z vein zone is exposed in two prospect pits and a railroad cut. The latter lies along the abandoned railroad bed 375 feet S. 27° E. of the Anna shaft rock dump. The vein strikes N. 30° E. and dips 30° northwest. On the east side of the cut the vein is 15 feet wide but narrows to about 9 feet on the west side of the cut. The vein is of moderately high grade nodular ore with much disseminated pyrite in a chloritic matrix. Much pegmatitic material occurs in the vein. Considerable pyrrhotite is present in small discontinuous lenses. The vein is enclosed in a garnetiferous and amphibolitic phase of the quartz-hornblende-biotite gneiss.

Two hundred feet southwest along the strike a shallow cross-trend prospect trench 50 feet long exposes a strongly magnetic graphitic and garnetiferous hornblende-pyrrhotite gneiss which strikes approximately N. 50° E. and dips 28° northwest.

A smaller prospect pit 440 feet southwestward along the strike from the above mentioned trench exposes a similar pyrrhotite-rich rusty

PLATE 11



A. View of part of the tailings from former milling operations at the Stella prospect

B. Outcrops of metagabbro in bed of Grass River below upper dam at Pyrites

gneiss which strikes N. 40° E. and dips 25° northwest. The three occurrences mentioned above are believed to delineate the approximate horizon of the Z vein, although the vein proper is probably exposed only in the railroad cut. This horizon is relatively much higher in pyrrhotite than are the other veins where exposed.

A fifth vein is indicated to lie below the Z vein, although it is probably discontinuous along the strike. On the slope just above the abandoned railroad 600 feet southeastward from the Anna shaft rock dump is a small patch outcrop of highly pyritic rusty gneiss striking N. 47° E. and dipping 25° northwest. About 400 feet southwest along the projected strike is a shallow prospect pit exposing about a foot of crumpled pyrite vein enclosed in typical rusty gneiss. A second pit lies 140 feet farther along the strike and exposes about a foot of vein material grading into pyritic rusty gneiss hanging wall. The vein here strikes N. 40° E. and dips 30° northwest. It is doubtful if this mineralized zone is of sufficiently high tenor and thickness to be of possible economic value.

The most conspicuous landmark of the Stella prospect is the large tailings pile seen from State Highway 87 near the eastern edge of the property. (See plate 11A.) This tailings pile covers approximately nine acres to an average depth of about 15 feet. Chemical analyses were run on two bag samples of the tailings collected at random to determine if the sulfur content of the tailings might justify reworking by modern milling methods. However, analyses of the samples ran 1.50 percent sulfur and 2.8 percent sulfur, so that the tailings are truly waste. Similar but smaller areas of tailings lie north and south of the Stella shaft.

The following account by Vogel (1908, pp. 847-850) detailing the milling processes used by the St. Lawrence Pyrite Company for ores from the Stellaville mines may give some indication of what might be produced from the ores by modern methods:

"The ore is carried from the mines to the mill by the railroad, where it is dumped into a receiving bin. . . . From the crude ore bin, which has a capacity of 1200 tons, the ore is drawn over a pair of grizzleys, spaced with 1-inch openings, the undersize falling into the boot of a Gates elevator, while the oversize goes through a No. 5, style "K", Gates crusher, which reduces the material to 1½ inches. By means of the Gates elevator, the crushed product as well as the undersize of the grizzleys is elevated into the crushed-ore bin, after the 1-inch oversize has been eliminated by means of a trommel screen, whence it is fed to Allis-Chalmers 14 x 24 "C" roughing rolls. The reduced material is then returned to the crushed-ore bin by means of the Gates elevator. From this bin the ore is drawn by a 12 x 24 plunger feeder which

delivers it, by means of a shaking screen, to a set of 26 x 15 type "A" rolls, which are set at about one-half inch. Water is used to assist the sizing of the material. The reduced material and the fines of the shaking screen are delivered, by means of the No. 1 mill elevator, to two conical trommel screens; these screens are arranged in pairs and are covered with punched steel plate with $\frac{3}{16}$ inch holes. The oversize is fed to three 2-compartment 24 x 36 roughing jigs, while the undersize is spouted to a pair of cylindrical trommels covered with punched steel plate with $\frac{3}{16}$ inch holes.

"The roughing jigs make a middlings product only and this is reground by a 36 x 15 rigid type roll and is then returned to the No. 1 mill elevator, while the low-grade tails are eliminated from the system. Another advantage of the roughing jigs is that they will separate any foreign material which comes into the mill, such as spikes, bolts, pieces of iron, copper wire etc.

"The oversize of the No. 2 trommels is fed to the No. 2 Hancock jig; the undersize is carried to a centrifugal pump and elevated to a five-compartment spitzkasten, where the coarse material is separated from the slimes. The No. 2 Hancock jig will make clean concentrates on the first four hutches, while the fifth hutch produces the middlings, which require recrushing. The sixth hutch makes the tails.

"The middlings from the fifth hutch are reground in a set of 36 x 15 rigid type rolls, the pulp being raised by the No. 2 elevator to a three-compartment spitzkasten. The coarsest material, which is drawn from the first and second hutches of this No. 2 spitzkasten, as well as the material from the No. 1 spitzkasten, is fed to the No. 1 Hancock jig, which will also turn out clean concentrates in the first four hutches, while the fifth hutch will produce middlings and the sixth hutch tails. The middlings from this No. 1 Hancock jig are recrushed on the 36 x 15 rigid rolls and follow the same rotation as the pulp of the No. 2 jig. Four 4-compartment 18 x 30 Harz jigs have been so placed in the mill that they will concentrate either the material fed to the No. 1 or No. 2 Hancock jigs in case of breakdowns or will help to take care of any excessive amount of feed.

"The slimes from the last hutches of the spitzkasten are fed to Overstrom tables and sometimes to one of the Harz jigs. All of the concentrates turned out by the different machines are spouted into the No. 3 elevator which raises them sufficiently high to run them into the concentrating bins. . . . No. 3 elevator is equipped with perforated buckets which give the concentrates an opportunity to partly drain before they reach the storage bins; these bins allow for further drainage. . . . The concentrates are spouted from these bins into boxcars, or gondolas, for shipment to the trade. They usually retain from 2 to 3 percent of moisture and vary from 40 to 48 percent in sulfur.

"The tailings are taken care of by either a centrifugal pump or an elevator, whence they are spouted onto the tailings pile. . . . These tails retain from 5 to 10 percent sulfur, the extraction varying from 70 to 80 percent."

The Stella prospect is located along an abandoned branch railroad that formerly ran from DeKalb Junction to Hermon. The property is

Plate 12

A. Outcrop of rusty gneiss and pyrite vein on east bank of the Grass River south of lower bridge at Pyrites. The rock on the right-hand edge of the outcrop is metagabbro.

B. Intensely plicated rusty gneiss underlying the pyrite vein in outcrop on east bank of the Grass River south of lower bridge at Pyrites

three miles by macadam road to the railroad at DeKalb Junction. Water for drilling purposes may be obtained in Elm Creek, which lies along the eastern margin of the mineralized area.

PYRITES PROSPECT

This prospect, formerly referred to as High Falls, is in St. Lawrence County, Town of Canton, Canton quadrangle. (See geologic map, plate 21.) The outcrops and old workings occur along the Grass River in and near the hamlet of Pyrites, about five miles south of the village of Canton.

The pyrite vein occurs in a narrow belt of typical rusty gneiss which is enclosed within a large body of metagabbro. The vein is exposed more or less continuously for a distance of six-tenths of a mile along the Grass River. Starting on the north end the vein is exposed in a trench and natural outcrop along the east bank of the river just south of the lower bridge across the river. Here the vein strikes N. 40° E. and dips about 55° northwest. It ranges in thickness from about 8 feet at the base of the outcrop along the river bank to almost 20 feet in the trench on top of the hill. The trench and adjacent stripped area are known locally as the "old copperas workings." About 600 feet east of the trench the vein is lost in a covered area.

The total thickness of rusty gneiss cropping out in the river bank just south of the bridge is about 115 feet. The vein occurs in the upper part of the gneiss and is underlain by 85 feet of intensely plicated rusty gneiss. (See plate 12.) In large part the thickness of gneiss exposed here is consequent upon the severe crumpling. The contact of the rusty gneiss and the underlying metagabbro is well exposed in the river bank at this place. The two formations here appear to be essentially conformable, with the contact striking N. 15° W. and dipping 35° northwest. Thirty or 40 feet upstream, however, the northwest dip of the foliation in the metagabbro flattens to about 20°.

In crossing the river the vein swings around to the south and is again exposed on the west bank of the river due south of the outcrops mentioned above. Here 12 feet of ore are exposed in two small adits driven into the vein on the side of the steep hill about 60 feet above the river. At this place the vein strikes about N. 35° W. and dips 40° southwest.

A series of small prospect pits trace the vein southward along the brow of the hill on the west side of the river, and for several hundred feet along the strike the rusty gneiss is exposed in the west bank of the stream. The vein crosses the river on the northern tip of the "island" formed by the river and the penstock from the upper dam to

the small powerhouse near the old paper mill ruins. Where it crosses the stream at this point the vein is only a few feet thick. It strikes N. 20° E. and dips 50° northwest.

On the right bank of the river at the lower end of the "island" is an old shaft now badly caved and probably flooded at depth. Old mine diagrams indicate that the workings extended down dip on the vein a distance of about 160 feet, and then drifted north under the river for about 150 feet.

Another shaft was opened on the vein about 500 feet to the south and was sunk on the incline to a depth of about 210 feet. A vein thickness of 8 feet is exposed in the entrance to this shaft and is underlain by 23 feet of relatively barren rusty gneiss on top of metagabbro. The vein and associated rusty gneiss strike N. 20° E. and dip 30° northwest. The vein as exposed here appears to be somewhat leaner than the average for the vein as a whole. It has a sheeted structure in which the pyrite tends to be concentrated into thin inch-scale layers alternating with quartzite and chloritic schist layers of similar thickness.

Several hundred tons of ore were produced from this shaft in 1907-08 by the Oliver Iron Mining Company and used in mill tests which yielded pyrite concentrates ranging from 43.4 percent to 46.57 percent sulfur and .038 percent to .046 percent phosphorous, with no arsenic. The Pyrites property is still owned by the Oliver Iron Mining Division, United States Steel Company, although no development work has been done since 1908.

The vein next crops out in the bed of the river, where it crosses to the northern end of the small island below the upper dam. During periods of low water the vein can be traced continuously across the bed of the stream to the lower end of the island, where it is completely cut out by the metagabbro. The vein here is about 15 feet thick and lies in the upper part of a 55-foot thickness of the rusty gneiss. In the stream bed considerable pyrrhotite occurs with the pyrite.

Throughout its exposed length the vein ranges in thickness from about 5 to 43 feet, averaging about 15 feet. The average sulfur content indicated by assays of drill cores, test pit samples and grab samples from adits by the Oliver Iron Mining Company is about 21 percent. Correlative assays for zinc average about .28 percent with a range of from .10 percent to 1.55 percent. Copper averaged about .02 percent with a range of from nothing to 1.03 percent. Phosphorus averaged .10 percent with a range of from .06 percent to .20 percent. Arsenic was absent except for a slight trace in a single analysis.

The most conspicuous rock at Pyrites is a dark metagabbro which lies above and below the pyritic rusty gneiss band. (See plate 11B.) The metagabbro varies in lithology from a chlorite schist to pyroxenic amphibolite. Most commonly it is a coarse hornblende-biotite-plagioclase gneiss with abundant development of chlorite and a little accessory magnetite, pyrite, apatite and quartz. Foliation is generally well developed, but locally it has uniform texture and looks like a dark, massive gabbro. Such phases of the rock commonly contain a little augite partially replaced by hornblende. Except very locally, the rock is wholly recrystallized and is characterized by the development of coarse poikiloblastic hornblende with abundant inclusions of quartz, magnetite and apatite.

The writer has not had an opportunity to make a detailed field and petrographic study of the metagabbro but tentatively follows Martin (1916, p. 61) in considering it to be a metamorphosed igneous rock. His interpretation is well substantiated by detailed petrographic studies and consideration of regional structural and stratigraphic relationships.

The pyritic rusty gneiss at Pyrites appears to be wholly enclosed within the metagabbro. Martin (1916, p. 44) stated: "The formation appears to be a xenolith in the gabbro, or nearly so; that is, if the stratum is anywhere attached to its parent Grenville country rock, it is by a very narrow connection at the northern extremity of the exposed mass, where a small area of garnetiferous and quartzitic schist approaches it from the northeast. On all other sides, the pyritous gneiss is seen to be inclosed by gabbro dioriti or amphibolitic rock whose igneous nature is unquestionable."

In the west bank of the river about 200 feet downstream from the upper island is a strongly foliated sheet of quartz-biotite gneiss abundantly injected by granitic material. This unit ranges in thickness from 15 to 50 feet and is both overlain and underlain by metagabbro. The gneiss lenses out into metagabbro 600-700 feet downstream but can be traced intermittently for more than 1,000 feet southwest along its strike. The quartz-biotite gneiss band and its foliation planes strike about N. 20° E. and dip 20°-30° northwest.

Two small lenses of marble within the metagabbro crop out along the road within a few hundred feet southwest of the lower bridge. The marble, which may be xenoliths, is only slightly silicated but contains a little greenish serpentine.

Individual Prospects

Five deposits, the Kilburn, Pleasant Valley School, Ore Bed School, Little River and Brick Chapel, do not occur in any natural grouping and will be considered below as individual prospects.

KILBURN PROSPECT

The Kilburn prospect is in St. Lawrence County, Town of Fowler, Gouverneur quadrangle. It occurs in a narrow arcuate belt of rusty pyritic muscovite schist that begins near the hamlet of Fowler and curves in a gentle arc from west through southwest to south for a distance of about four miles. The schist band is about 200 feet thick and is more pyritic toward the hanging wall contact than lower down in the formation. It has been prospected in a series of shallow pits, but the principal opening, the Kilburn pit, lies about 1,000 feet N. 30° E. of the abandoned farm home half a mile northeast of Mud Pond.

The pyritic schist at the Kilburn pit probably would not run higher than 10-15 percent sulfur. It is only slightly more pyritic than the major portion of the pyritic schist belt and is not considered to be a significant concentration of the sulfide. Fine-grained sparsely disseminated pyrite and widely spaced laminations of pyrite less than half an inch wide, with occasional knots of pyrite and quartz several inches across, which characterize the pyritic schist throughout its extent, comprise the only showing of ore minerals at this place. The schist here strikes N. 75° E. and dips 40° northwest.

The pyritic micaceous schist is underlain by a siliceous silicated marble which crops out abundantly. Another belt of marble underlies the schist in part, but toward the middle and the southwest half of the belt a dark amphibolitic band intervenes between the schist and the marble.

On the northeast end of the belt considerable hematite occurs in the top of the schist and several pits were formerly operated in it for iron ore. The largest of these, now flooded, lies at the base of the low ridge one-fourth of a mile west of Fowler.

Data collected from abundant outcrops along the belt indicate that exploration by diamond drilling would not be warranted.

PLEASANT VALLEY SCHOOL PROSPECT

This prospect is in St. Lawrence County, Town of Edwards, Gouverneur quadrangle, about one mile south of Talcville. An abandoned shaft, now flooded, of unknown depth is located one-fourth of a mile northeast of Pleasant Valley School, a few hundred feet northeast of the bridge across Pork Creek and about 200 feet east of a narrow dirt road.

The sulfide mineralization, which is here largely pyrrhotite, occurs in a lens of brownish quartzite included in a narrow prong of rusty gneiss which is a southwestern extension of a folded sheet of rusty

gneiss intercalated with the Grenville marble southeast of Talcville. The quartzite appears to be an exceptionally quartzose phase of the rusty gneiss.

Just above the old shaft two nearly-vertical veins of massive pyrrhotite can be traced for 15 to 25 feet to the shaft. They vary in thickness from 2 to 3 feet. At the shaft they join in a lens to form a body of pyrrhotite about eight feet wide. An eight-inch vein of massive pyrite intergrown with quartz occurs along the northwest wall of the coalesced pyrrhotite vein in the shaft. Only disseminated traces of pyrite occur with the pyrrhotite veins and the pyrite vein is entirely devoid of pyrrhotite. Neither the pyrrhotite nor the pyrite can be traced beyond the shaft toward the southwest, and it seems clear that the massive sulfides form only a small discontinuous lens in the enclosing gneisses.

The quartzite in which the pyrite and pyrrhotite veins occur contains abundant disseminated graphite flakes and a little disseminated pyrite. Oxidation of the latter gives a somewhat rusty appearance to the rock, but it is not a typical rusty gneiss and lacks the characteristic chlorite. Occasional quartz-pyrite knots up to several inches across occur in the quartzite, especially close to the veins. The quartzite lens is about 100 feet wide and several hundred feet long, and is conformably enclosed in typical rusty gneiss. The rocks strike N. 55° E. and dip 55°-85° northwest. A good outcrop of dolomitic marble, which overlies the rusty gneisses here, lies 20 feet north of the old shaft. Its strike is N. 35° E. with a 50° dip northwest.

About a mile northeast along the strike a prospect pit in the typical rusty gneiss on the knoll just south of the road bares a sheeted pyritic gneiss striking N. 75° W. and dipping 75° northeast. The gneiss here is not rich enough in pyrite to be considered as possible ore.

The Pleasant Valley School deposit is not considered to be worth drilling as a pyrite prospect. Abundant outcrops in the area clearly develop an unfavorable picture.

ORE BED SCHOOL PROSPECT

This prospect is in St. Lawrence County, Town of Hermon, Gouverneur quadrangle, 2½ miles southwest of Hermon village. The pyritic rocks crop out along the low hill one-fourth of a mile north of Ore Bed School and may be reached from an abandoned field road that runs along the top of the hill. Along the base of the hill on the northwest side are several water-filled pits from which a low-grade hematite ore was excavated many years ago. The iron ore occurs in a hematitic quartz chlorite gneiss overlying pyritic rusty gneisses.

Two veins are exposed in outcrops of rusty gneiss which is part of the large gneiss belt extending northeast through the vicinity of

Hermon village. The gneiss near the Ore Bed School prospect varies considerably in lithology and is intimately mixed with granitic and pegmatitic material. Essentially it is a quartz-biotite gneiss, but it contains several rusty pyritic and chloritic zones and at least one sillimanitic zone. The gneiss and included pyritic layers strike N. 47° E. and dip 35°-45° northwest.

About five feet of relatively low-grade vein material is exposed just south of the road which runs along the top of the hill, and about three-tenths of a mile northeast of the Ore Bed School road. The outcrop is about 40 feet long and much weathered so that it is difficult to ascertain much about the limits of the vein. The second vein is exposed on the northwest slope of the hill several hundred feet northeast of the house on the Ore Bed School road. Here about 2½ feet of coarse nodular pyritic ore are exposed with neither hanging wall nor footwall exposed.

There is little to encourage diamond drilling of this prospect, although it is possible that covered mineralized zones are present. Systematic traverses along and across the projected strike of the outcropping rusty gneiss bands failed to discover any significant sulfide mineralization. The flooded hematite pits would supply adequate water for drilling purposes. The prospect is five miles from the railroad at DeKalb Junction by dirt and macadam roads.

LITTLE RIVER PROSPECT

The Little River deposit is situated in St. Lawrence County, Town of Russell, Russell quadrangle. The only outcrops of the pyrite occur in the bed of the Little River less than 500 feet south of the north limit of the Russell quadrangle and about 200 feet downstream from the O'Brien Farm hematite prospect. A steep rounded hill of glacial drift 120 feet high lies on the left bank of the stream just above the outcrops. At high water the outcrops may be entirely submerged, but normally they are well exposed and can be walked out from end to end across the stream. The adjacent iron prospect was drilled some years ago by the Shenango Furnace Company, but no pyrite was reported in the three short holes put down. However, it is believed that the drilling was started below the pyrite horizon.

The pyrite vein is exposed in the bed of the stream for a total length of 80 feet along the strike. It strikes N. 60° E. and dips 15°-20° northwest. Possible extensions in either direction are obscured by a thick mantle of glacial deposits. The vein thickness exposed is 12 feet, but figuring on the interval between the uppermost exposed part of the vein and certain footwall, a thickness of 60 feet could be possible.

The hanging wall of the vein is not exposed, so that the maximum possible thickness cannot be estimated.

The pyrite occurs in a dark green chloritic matrix with abundant graphite disseminated in minute flakes. The pyrite occurs in irregular reticulating veinlets, as fine disseminated grains, and in abundant coarse nodules up to four inches in diameter. The tenor of the vein material appears to be uniform throughout the outcrop. Chemical analysis of representative grab samples indicates the vein averages 19.3 percent sulfur.

Underlying the vein is a quartz-feldspar gneiss 25 feet thick, which in turn is underlain by an impure marble of undetermined thickness. The quartz-feldspar gneiss in large part constitutes a tectonic breccia, which probably marks a zone of local crustal adjustment after the major folding and metamorphism of the region had subsided. The underlying marble was the formation drilled for iron, which apparently occurs only in small isolated pods at this locality.

The Little River pyrite prospect is very poorly situated with respect to transportation. No roads give direct access to the prospect. It is four-fifths of a mile east cross-country or three-fourths of a mile south upstream to the nearest dirt roads, thence via dirt and macadam roads another eight miles to the railroad at Canton. Water for drilling purposes is available in Little River the year round.

BRICK CHAPEL PROSPECT

This undeveloped prospect is in St. Lawrence County, Town of Canton, Canton quadrangle, on the east side of the Canton-North Russell Road about midway between the two places, or three miles southeast of Canton. Principal outcrops are on the low rusty-colored hill just east of the intermittent stream one-fourth of a mile southwest of Brick Chapel.

Along the top and southeast side of the low rusty-colored hill a pyritic rusty gneiss can be traced continuously in outcrop for about 800 feet. Total thickness of rusty gneiss exposed on the hill is about 110 feet. It strikes N. 53° E. and dips 25°-30° northwest so that the outcrop breadth is about 250 feet across the strike. The abundant gossan imparts the conspicuous color to the hill. A 15-foot-thick zone in the rusty gneiss is relatively high in pyrite and constitutes the vein. A nine-foot channel sample cut across part of the vein analyzed 26.2 percent sulfur. The top and bottom of the vein are not well defined, and the limits of the ore zone would be determined by a grade zone cutoff. The pyrite in the vein is disseminated for the most part but is concentrated locally into thin layers and stringers parallel to the foliation, with occasional coarse nodules several inches across.

The vein material is the typical pyritic quartz-chlorite gneiss with abundant disseminated graphite. The enclosing rusty gneiss is less pyritic and contains considerable muscovite in addition to chlorite. Locally it is highly schistose.

The rusty gneiss belt can be traced intermittently for about 2,300 feet southwest along the strike. Toward the southwest end the trend swings around to N. 10° E. and dips under conformable hanging wall marble. It is overlain by a thick garnetiferous quartz-biotite gneiss. The gneiss band crops out along the road where it crosses between the opposing farmhouses 2,000 feet south of the schoolhouse intersection on the Canton-North Russell Road and can be traced another 500 feet to the southwest before it is lost for lack of outcrops.

The Brick Chapel prospect is 3½ miles by dirt road from the railroad at Canton. A reliable source of water for drilling can be had in Little River half a mile to the east, and seasonally in the small intermittent stream that flows across the rusty gneiss belt.

FUTURE POSSIBILITIES OF THE PYRITE DEPOSITS

The ultimate utilization of St. Lawrence and Jefferson Counties pyrite deposits depends upon two principal factors: (1) world-wide supply of and demand for sulfur, and (2) magnitude of pyrite reserves in the mineralized belt.

Predictions of future world supplies of sulfur, including brimstone and other sources, are somewhat less certain than predictions of greatly increased consumption of sulfur and its derivatives during the next few decades. It seems almost certain, however, that sulfides—especially pyrite and pyrrhotite—will assume an increasingly important role as a raw material for sulfuric acid and manufacture.

The principal former producers of pyrite in the region are the Cole and Stella mines. Both of them produced considerable ore of average tenor or better, and there is no indication that they closed because they were depleted, but rather because they could no longer compete economically with the low-cost brimstone deposits of the Gulf Coast. Because their workings are no longer accessible, it would be necessary to rely almost entirely on a diamond drilling program to prove or disprove a sizeable body of ore remaining. The enlargement of mill and mine installations at the Cole mine immediately preceding the unforeseen depression in the pyrites market following World War I suggests that considerable ore of the quality previously mined still remains underground. In the light of the above considerations, the Cole and Stella properties would merit drilling exploration under suitable economic conditions.

The Dickson and Wight prospects, considered as a unit, are perhaps the most promising of all the undeveloped prospects. If these prospects are considered individually, the quantity of possible ore is probably not sufficient to sustain ultimate mining; but if the two prospects are connected by a continuous zone of sulfide mineralization, as appears to be the case, the picture would be encouraging. If two or three short diamond drill holes were put down in the covered area between the two prospects and indicated a continuous vein from one to the other, a more-extensive drilling program would be warranted.

After the Dickson-Wight prospects, the Gold Hill deposit is the most promising of the wholly undeveloped prospects. A limited series of short diamond drill holes spotted to test the probable continuity of sulfide mineralization across the covered area south of the vein outcrops on Gold Hill, and several short holes to test the possibility of vein material underlying the narrow valley between Gold Hill and the precipitous granite gneiss ridge to the west, would suffice to show

whether or not the Gold Hill prospect might make a mine. To be of economic value, however, the Gold Hill Prospect would have to yield a sulfide deposit big enough and rich enough to offset the disadvantage of rather unfavorable transportation facilities.

The Morgan, Keene and Caledonia prospects do not hold great promise as individual deposits, but as connecting links in a possible mineralized zone several miles long they are of some importance. For testing the possible continuity of mineralization in a zone which includes the three prospects, a series of holes should be spotted progressively away from the known exposures of vein material and along the projected strike. Initial spacing of holes away from the prospects could be in the neighborhood of 800-1,000 feet, with progressively increased spacing in successive holes. Providing suitable options could be arranged, such exploratory drilling would not be excessively expensive because of the convenient accessibility of the area, adequate water supply and soft nature of the formations to be drilled.

At the Little River prospect so little of the pyrite vein is exposed along the strike that any additional knowledge of the deposit must come from exploratory drilling. Such a program should consist of a series of short holes spotted to intersect the strike projections of the mineralized horizon. However, the very unfavorable situation of the prospect with respect to transportation detracts somewhat from the future possibilities.

The Brick Chapel prospect shows considerable promise, but proved continuity of a significant vein thickness throughout the entire length of the traceable rusty gneiss belt would be necessary for the deposit to be of further economic consideration. Such continuity could be proved or disproved by several short drill holes spotted southwest along the rusty gneiss belt where the bedrock is largely covered. Inasmuch as a grade-zone cutoff is indicated for the vein walls on the hill southwest of Brick Chapel, diamond drilling would be necessary to delimit the thickness as well as the strike length and depth of the vein.

At the Hendricks prospect the pyrite vein is too thin to be of economic value, but as an horizon marker on a probable mineralized zone continuous with the veins at the Cole mine 1½ miles southwest the prospect is a valuable control point for any diamond drill program which might be planned to test the covered area intervening between the two prospects.

The Pyrites prospect is pretty much an open book because of the numerous outcrops and exposures along the extent of the vein. The relatively low tenor of the vein coupled with a generally thin but

variable thickness, and operational difficulties related to the sinuosity of the vein and the deep dissection by the Grass River, add up to an unfavorable prospectus for the deposit. The certain and abrupt termination of the vein on the south end, and the apparent pinching-out on the north end, preclude the possibility of discovering strike extensions of the known vein.

The economic possibilities of the Oxbow Southwest prospect are enigmatic and will remain so until drilling data are available. From present surface indications the northern part of the prospect holds little promise because the vein there is thin and relatively low-grade. The relatively high-grade and apparently wide vein on the south end is more encouraging, but it may be that the local intense folding has produced an apparent thickening of the vein at that place only. Outcrop indications are strong that the vein thins rapidly in passing north from the locus of severe crumpling. The unfavorable location of the prospect with respect to transportation further detracts from its potentialities.

Because of the low tenor of the veins or the small extent of the deposits the following prospects are considered not to have any economic potential at the present time, nor under any foreseeable future conditions: Stiles, Mitchell, Farr, Ore Bed School, Pleasant Valley School, Kilburn.

The economic potential of the pyrite belt may be enhanced somewhat by considering the possibility of developing one or more deposits to feed central milling facilities and supply the sulfite needs of local paper mills.

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During some as yet undetermined period prior to about 10,000 years ago, hunters equipped with the heavy fluted points of the Clovis industry roved about in the well-watered and partly wooded areas of the southern plains, adjacent Rocky Mountain foothills, Colorado Plateau and portions of the now desert basin area of New Mexico and Arizona. Especially graphic records of this epoch have been revealed at Clovis, N. Mex.; Lubbock, Tex., and at Naco and Hereford, Ariz. At these places occur "kill sites" of mammoth, horse, camel, bison and other late Pleistocene fauna, in lacustrine or fluvial deposits indicative of moist and probably cool climatic conditions.[1]

At Clovis and Lubbock there is geologic record of a succeeding long span of extreme aridity which current comprehension finds incongruous, temporally or stratigraphically, with the postglacial dry cycle, or Altithermal phase of Antevs, estimated to have occurred between approximately 7,000 and 4,000 years ago.[2] The earlier arid interval would seem rather to be referable to the Cary-Mankato or Two Creeks Interstadial episode, radiocarbon dated between 13,500 and 11,000 years ago.[3] Conceivably during this long stage of relative dryness, some of the early hunters and the large beasts upon which they primarily depended for subsistence temporarily abandoned parts of the area for more propitious regions, perhaps in the distant and less arid eastern United States.

Both geologic and archeologic data in the southern High Plains attest to a subsequent period of moist, cool climate responsible for accumulations in various parts of Texas and New Mexico of diatomaceous earth or humic soils, productive of the generally smaller and more finely chipped fluted points of the Folsom category, associated with the bones of the principal quarry at this period, *Bison antiquus.*

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[1]Howard, 1935, pp. 79–100; Cotter, 1937; Wormington, 1949, pp. 33–45; Sellards, 1952, pp. 17–46; Haury, 1953, pp. 1–24; Krieger, 1956, p. 452.
[2]Wendorf, Krieger, Albritton and Stewart, 1955, pp. 69–99; Antevs, 1953*a*.
[3]Suess, 1956, p. 356.

A radiocarbon date of 9,883 ± 350 years on carbonized bison bones from the Lubbock locality, suggests that this pluvial or relatively wet episode was related to the Mankato and/or Valders advance in the north.[1]

In the Northeast, this advancing glacier was impounding in various portions of the Huron, Erie and Ontario basins, the deep icy waters of Lake Warren, one of a succession of glacial lake stages in this region, and still farther east Lake Vermont was being created in the Champlain Lowland.[2] There seem neither actual nor theoretical grounds to support the belief that any human being had up to this time, about 11,000 years ago,[3] penetrated into the bleak northeastern forests, predominantly of spruce and fir,[4] and still the probable habitat of the mastodon.[5]

In the southeastern United States, however, well beyond the range of the glaciers, conditions within the deciduous forests and possible grassland extensions from the west may long have been favorable for early hunters. The widespread occurrence of points generally conforming to the Clovis pattern suggests this possibility, but unfortunately without affording the supporting testimony of faunal remains or the discovery of radiocarbon datable material.

In the Northeast area, geologic evidence suggests the post-Valders maximum age of the fluted points, which in the main fall within the established range of the Clovis type, and the probability that the first hunters entered this section of the country, perhaps from a southerly or southwesterly direction, after relatively modern conditions of topography, climate and presumably flora and fauna had become established here, following the disappearance, estimated at around 7,000 years ago, of the final glacial bodies of water, Lakes Iroquois and Vermont.[6]

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[1]Sellards, 1952, pp. 47–60; Wendorf, Krieger, Albritton and Stewart, 1955, pp. 68–69, 71–76, 98; Forbis, 1956; Suess, 1956, p. 356; Libby, 1955, p. 107.

Alex D. Krieger, who visited me on October 5, 1956, and was kind enough to read the manuscript of this paper and offer constructive criticism, suggests *Bison taylori* as the preferred nomenclature, since *B. antiquus* has not been established as a distinct species.

[2]Fairchild, 1909, 1919; Chapman, 1937; Hough, 1953.

[3]Suess, 1956, p. 356; Flint, 1956, p. 272.

[4]By conversation with Paul B. Sears, April 8, 1954.

[5]The latest direct evidence bearing on this association comes from the Colgan farm, near King Ferry, Cayuga Co., N. Y., where a mastodon skeleton occurred embedded in clay beneath a layer of peat and muck. Needles of black spruce and balsam fir, together with wood and cones of the spruce were recovered (August 1955) *in situ* from the clay near the bones by Dr. Clair A. Brown, professor of botany, Louisiana State University. A fragment of this wood supplied by Dr. Brown has recently been sent by the writer to Dr. Edward S. Deevey for radiocarbon analysis at the Geochronometric Laboratory of Yale University.

[6]Flint, 1953, plate 3; 1956, p. 272.

Until recently the sole basis for the assumption of a paleo-Indian horizon in the eastern United States comprised the random surface distribution from Alabama to New Brunswick of fluted points of somewhat variable form, but exhibiting certain consistent features of construction and such details of treatment as smoothed lower edges and base. Actual campsites have now been identified and have produced, in addition to fluted points, a small complex of relatively simple, mainly uniface, flake implements, consisting principally of end and side scrapers, knives and gravers. Yet even within the limited range of this complex, as manifested at the Quad site, northern Alabama;[1] Parrish site, northwestern Kentucky;[2] Williamson site, southeastern Virginia;[3] Shoop site, eastern Pennsylvania;[4] Reagen site, northwestern Vermont,[5] and Bull Brook site, northeastern Massachusetts,[6] there is a sufficient variation in formal detail and quantitative distribution to suggest still uninterpretable spatial and/or temporal differences.[7]

In New York State we continue to seek an assemblage of this kind, marking a favored camping spot. Helpful leads emerge from the distributional plotting of fluted points, shown on figures 1, 2, since certain loci are revealed as potential centers of concentration. Unhappily, the exact provenience of the majority of the specimens seen in museums and private collections is unknown, because they were collected prior to 1926, when the temporal significance of the fluted form of point was first recognized.[8] As "one of the rarest" of the "distinct varieties of the triangular arrows," Beauchamp had long before remarked upon this form, but since an example was found within a prehistoric, earth-walled town site on the Seneca River in central New York, he postulated an Iroquoian origin.[9] In the writer's study it has been possible in most cases to localize the finds to townships, while in a few instances the farm, field or even, rarely, a more precise find-spot is ascertainable (see table 1). Considerable pains and effort have been expended to collect, check and verify these data and to determine from the finders, wherever possible, information regarding

[1]Soday, 1954, pp. 1–20.
[2]Webb, 1951, pp. 432–450.
[3]McCary, 1951, pp. 9–17.
[4]Witthoft, 1952, pp. 464–495.
[5]Ritchie, 1953, pp. 249–258.
[6]Byers, 1954, pp. 343–351.
[7]Witthoft (1952, p. 492) has suggested a division of the eastern sites into two industries, an earlier or Enterline (Shoop, Williamson, St. 4) and a later or Parrish (Parrish, Wilhelm, Reagen). Almost certainly this is an oversimplification of the facts.
[8]Cook, 1927; Figgins, 1927.
[9]Beauchamp, 1897, p. 21. The specimen shown in his figure 13 is illustrated in plates 2A, B, figures D, d.

terrain and associations with other artifacts. The results of this first distributional study seem, therefore, to admit of certain provisional deductions with respect to probable derivation, affinity and relative age in the cultural succession in the Northeast.

They also serve to emphasize the absolute rarity in this area of traces of the earliest hunters, although in this respect the disparity with regions immediately to the south and west does not seem especially marked. There is, however, in the eastern United States, a progressive diminution in incidence of fluted points both to the north and south of a zone of relative concentration extending eastward through the Ohio and Tennessee valleys into Virginia.[1] This pattern of distribution, as later mentioned, suggests the existence at some former time of a favorable migration corridor into the east.

This scarcity of fluted points and especially of fluted point stations is in striking contrast to the prevalence over the whole eastern United States of surface-strewn artifacts and components of various Archaic manifestations, with which, in the Northeast, no continuity or only a tenuous linkage with the fluted point industries can be demonstrated.[2] Such a continuity, through a succession of nonfluted point forms, is to date best indicated in the Middle and Far West.[3]

The distributional evidence leads to the conclusion that the fluted point users in the Northeast, as probably elsewhere, comprised a wide scattering of tiny bands, in all likelihood limited to a few families, of great mobility and primarily dependent for sustenance on large game mammals.[4] Whether these animals included now extinct species surviving from the late Pleistocene or a modern fauna including the Virginia deer, black bear, elk and moose, the principal big game of the succeeding Archaic hunters is still to be determined. The discovery at Bull Brook, Massachusetts, of charcoal granules and calcined bone fragments suggesting deer remains about a hearth augurs well for an

[1]Shetrone, 1936; Crozier, 1939; McCary, 1947, 1948; Miller, 1950, pp. 273–275; Witthoft, 1950; Fowler, 1954; Mahan, 1954; Mayer-Oakes, 1955, pp. 44–50, 72–74, 89–90, 130; Krieger (by conversation).

[2]Ritchie, 1953, p. 257.

[3]Mayer-Oakes, 1951, pp. 321–322; 1955, pp. 18–20; Willey and Phillips, 1955, pp. 731–732.

[4]The broad range of diet of the Clovis hunters is illustrated by the notable discovery, beginning in February 1956, of a series of buried hearths near Lewisville, Denton County, Texas. Members of the Dallas Archeological Society found in association with a Clovis point and charcoal, remains of "two tortoises, a large bison, a large wolf (?), rabbits, split bones suggestive of small deer or antelope, birds, three small mussel shells, and a snail shell, all burned and *in situ* in the hearth pits" (Krieger, 1956, p. 106).

ultimate solution of this problem.[1] While nothing in the surviving chipped stone inventory can be construed as fishing gear or equipment for the preparation of wild vegetal foods, it is difficult to conceive of a primitive food-gathering society which would totally ignore these dietary supplements to a hunter's fare. Willey and Phillips point out that large portions of the New World were pioneered on this level of culture,[2] and archeological investigations in the Northeast, and throughout the eastern United States in fact, have adduced evidence of fluted point dissemination supporting the assumption that paleo-Indian hunters enjoyed as nearly a condition of free wandering in search of food in an unoccupied country as has ever existed in the history of man.

Despite the wide latitude of fluted points indicative of extensive exploration and open territory, the distributional pattern signifies preference for certain kinds of terrain, as well as for particular locales. Thus a predilection for well-elevated situations is attested by a majority (26 or 31.7 percent) of the determinable find-spots of fluted points in New York and by the locations of all known paleo-Indian components in the East. In central and southwestern New York, however, a total of 10 (12.1 percent) fluted points have been found on and about the margins of low swampy ground formerly occupied by shallow lakes and, in subsequent times strongly attractive to Archaic and other cultural groups.[3] For six additional specimens the locus may be described as only slightly or moderately elevated (a few to about 10 feet) above the general surrounding level, while for nearly half (40 or 48.7 percent) data of this kind are unobtainable. (See table 1.)

The paleo-Indian also shared with a majority of his successors a decided choice for main waterways. The thin scatter of fluted points in the Northeast follows the principal river systems, and it would appear that the primary movements had originated to the south and southwest of the area. Thus a trail of fluted point users seems to ascend along the Ohio and Allegheny Rivers into southwestern New York; another to follow the Susquehanna and Delaware systems from Pennsylvania into central New York; while yet another to lead northward through the Hudson Valley. The Long Island Sound coastline of southern New England, continuous with the Atlantic Coastal Plain, appears to have provided a fourth route from which entry was

[1]Byers, 1955, pp. 274–275.

[2]Willey and Phillips, 1955, p. 731.

[3]Archaic components are also recorded at the Parrish, Quad and Williamson sites.

effected into river valleys like the Connecticut, and as far north along the coast as Mount Desert Island, Maine[1] and Quaco Head, St. John, New Brunswick.[2] It is of interest to observe that the Shoop site is located on a small tributary of the Susquehanna; the Reagen site on the Missisquoi River, flowing into the northern end of Lake Champlain, closely related by the Lake George connection to the Hudson Valley route; while the Bull Brook component is readily accessible from the postulated coastal approach. (See figures 1, 2.)

Large, fertile valleys, their environs and the Coastal Plain supported the heaviest populations of food animals and the aboriginal men who fed upon them in later prehistoric and early historic times, and there is little doubt of a similar ecological relationship in a still more ancient period. The absence or extreme scarcity of fluted points and subsequent cultural remains from large regions like the Adirondack and Catskill Mountains and the rugged, folded mountain and ridge country separating New England from New York east of the Hudson-Champlain Lowland, is probably thus best explained.

It is, however, obvious that the early hunters penetrated inland from the major river valleys, following smaller tributary streams into the rough uplands seldom used by Archaic peoples. While the occasional discovery of a fluted point in a remote mountain valley or terrace may connote only the place of death of a large game mammal, struck many miles away and lost to the hunter, enough instances of this kind in Pennsylvania and New York lead rather to the suppositions outlined.

As a minor digression, the possible knowledge of water travel at this early time is raised by the finding of two examples of fluted points on eastern Long Island, one near Greenport on the northern fork (figures 1, 2 and plates 10A, B, figures E,e), the second near Bridgehampton on the south fork (plates 10A, B, figures D,d). I am informed by Roy Latham[3] of Orient, Long Island, that there are no records of the freezing over of Long Island Sound to complete a land bridge from the Connecticut coast, but a winter crossing of the Hudson from the New York mainland to the western end of the Island is entirely plausible. The total absence from all paleo-Indian complexes in the country of ground stone, wood working tools (adzes, celts and gouges) probably essential to the felling and shaping of tree trunks into dugout boats, leaves us only with the possibility that on occasion a frail bark craft, or a rude driftwood raft may have

[1]Fowler, 1954, pp. 4–6.
[2]Cotter, 1937*a*, p. 36, f.n.
[3]By letter of January 20, 1956.

been employed in the crossing of streams. Along the broad and deep Hudson River, however, all recorded fluted points have come from the west side (figures 1, 2). The Susquehanna, Delaware and Allegheny Rivers, on the contrary, are and have been in historic times, fordable at many places.

As already implied, the distributional evidence suggests that the immediate source of the fluted point hunters lay to the south and southwest of our area, rather than to the north. Adjacent Ontario, Canada, has provided only 11 recorded finds beyond the example of western New York Onondaga flint, from Point Jarvis about 60 miles west of Buffalo, on the north shore of Lake Erie.[1]

Witthoft has expressed a contrary view, deriving the occupants of the Shoop site from western New York State on the basis of the predominance of western New York Onondaga flint as tool material.[2] He apparently holds to the hypothesis of the progressive south-southeastward drift across Canada from an Alaskan bridgehead of a primary influx of Asiatic hunters in late Pleistocene times, bringing, more or less directly, an offshoot of early New World immigrants into New York and Pennsylvania.[3]

I am not aware that evidence for such a postulated spread of fluted point people can be demonstrated over large sections of the implied route, nor do the data of distribution already adduced for the New York area, and the correlation with geological features, still to be discussed, appear to support this view. Moreover, as Krieger has pointed out, the technique of fluting points may well be an American invention.[4]

Witthoft stresses the probable significance for a study of paleo-Indian group movements of source identification of the lithic materials utilized in tool manufacture. He mentions the extensive employment for fluted points in eastern Pennsylvania of the distinctive local jasper and indicates the dissemination of jasper points into New York State.[5] In plotting the distribution of the recorded fluted points shown in figures 1, 2, I included in the original draft, wherever possible, symbolic references to lithic composition, insofar as it could be identified with the aid of the microscope and the assistance of geologists.[6] One

[1]Kidd, 1951, p. 260. I am indebted to Richard L. McCarthy, Lockport, N. Y., for data on the Point Jarvis specimen.
[2]Witthoft, 1952, pp. 470–471, 493.
[3]Ibid., pp. 493–494.
[4]Krieger, 1954, pp. 274–275.
[5]Witthoft, 1950, p. 50.
[6]Flint samples collected by the writer and others on New York, Pennsylvania and Vermont quarry sites and at flint exposures in New York proved very helpful, as did the study of New York flints by Wray, 1948. I am especially indebted to Dr. John Prucha, formerly of the New York State Museum and Science Service, Geological Survey, for helpful assistance.

source of difficulty lay in the variable degrees of weathering of some of the specimens, while another arose from the fact that after abstracting the points of jasper, Onondaga, Deepkill, Normanskill, Little Falls, Leray and other more or less readily identifiable local flints, there was a residue of unfamiliar exotic flint materials of indeterminate provenience. These provoked the conclusion, shared with Witthoft,[1] that a knowledge of the derivation of such materials might well clarify the direction of earliest movements into the area of the bearers of the fluted points.

In brief, the writer's analysis of the lithic constituents of fluted points available for examination may be summarized as follows: Identifiable Pennsylvania jasper (yellow, brown and red) points occur sporadically to the north of the chief quarry centers in Lehigh, Bucks and Berks Counties, Pennsylvania, appearing most commonly along the courses of the Delaware, Susquehanna, Hudson and Wallkill Rivers. A thinner line leads eastward, following the New England coast, terminating apparently at Bull Brook.[2] There is also a sprinkling of such points along the Genesee, Seneca and Oneida Rivers, while a single point from the shore of the St. Lawrence at Cedar Point, Jefferson County, is of this material. The native eastern New York gray, greenish gray, and green Deepkill flint, and green, red, black and gray, sometimes color-banded Normanskill flint comprise the majority of points from the Hudson, eastern Mohawk, Lake George and lower Champlain Valleys, and have been recognized at Shoop and probably at Bull Brook.[3] Fluted points from central, western and southwestern New York and adjacent Pennsylvania are predominantly fashioned from gray, blue-gray and mottled gray and tan, high quality Onondaga flint. This is obtainable, with local variation in color and markings, which provide useful clues to the approximate district of derivation, in a broad band of outcrops across central New York, from the Niagara Peninsula of Ontario to near the Hudson Valley, thence ranging south-southwestward into New Jersey and Pennsylvania at the Tri-States district.[4] The majority of the Shoop site artifacts are described by Witthoft as of deeply weathered

[1]Witthoft, 1952, pp. 470–471.
[2]Byers, 1954, p. 345. Maroon colored jasper outcrops are said to occur in eastern Massachusetts. Megascopically, the New England and Pennsylvania jaspers seem to be distinctive, the latter being more lustrous and frequently carrying small quartz veins and crystal clusters. In thin section, according to Witthoft (personal communication), Pennsylvania jasper shows a clear matrix of cryptocrystalline quartz, with scattered quartz crystals and fine, flocculent iron dust, while many additional gross impurities occur in New England jasper.
[3]Witthoft, 1952, p. 470; Byers, 1954, p. 345.
[4]Wray, 1948, pp. 40–41.

mottled Onondaga flint, characteristic of western New York and southern Ontario exposures.[1] Minor representations of Little Falls whitish flint, Leray black flint and other New York varieties have been definitely or tentatively recognized in fluted points usually found not far from potential sources of supply.

A consideration of these and other pertinent facts[2] leads to the provisional assumption that fluted point people entered various regions of the Northeast by following major river courses. They seem to have been equipped with hunting points and other flaked tools of more simple character, identified as yet on only a few sites (Shoop, Reagen and Bull Brook; see plates 12-18; cf.11), which were fashioned from high grade flints (or other lithic materials) foreign, insofar as known, either to the area as a whole,[3] or to the particular region of occurrence. The subsequent explorations of these hunters revealed local supplies of good quality flints on which they then came to depend. The relatively considerable amount of Pennsylvania jasper, together with the pattern of its distribution, leads one to suspect that paleo-Indian people may have been resident in eastern Pennsylvania until climatic and other conditions to the north in New York State and New England became more favorable. Since points made of eastern and western varieties of New York flints appear in some numbers in Pennsylvania, one might hypothesize seasonal movements back and forth along the stream valleys.[4] (Perhaps the exclusively west bank distribution of fluted points in the Hudson Valley is to be explained by summer migrants, whose cultural equipment was unequal to the crossing of this wide and deep river.)

Certain typological disparities occur in the fluted point series in the Northeast which find parallels elsewhere in the United States. Since on the few components recognized in our area there are accompanying variations in frequency and form among the scraping, cutting and graving tools, the differences may depend upon time distinctions more than areal specializations. Witthoft has argued for an underlying early Enterline Industry at the Shoop and Williamson components.[5] Byers sees Enterline and possibly Folsom elements at

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[1]Witthoft, 1952, p. 471.

[2]See discussion of the Reagen site stone sources in Ritchie, 1953, pp. 250–251.

[3]Three points from western New York (plates 5A, B, figures E,e and plates 10A, B, figures A,a), and one from Tioga County (plate 9, figure B), are made of dark bluish flint with lighter markings; two others (plates 1A, B, figures I,i, and plates 2A, B, figures G,g) from central and northern New York, respectively, are chipped from a mottled light gray flint. The material of all is believed to be Upper Mercer flint from eastern or southeastern Ohio (Shetrone, 1936, p. 255).

[4]The conditions reported for the Shoop site seem at variance with this postulation.

[5]Witthoft, 1952, pp. 485–487.

Bull Brook.[1] The Reagen complex, the most aberrant fluted point site in the Northeast, suggests a still later level of assimilation. Its traits, however, include a small number of scrapers with possible graving spur (plate 12, figures A, EE; plate 13, figure X), characteristic of the Enterline Industry, the pentagonal fluted point of the Williamson complex (plate 15, figures I, J), and the multipointed fine graver of the Bull Brook assemblage (plate 13, figures HH; plate 17, figure Q).[2] Moreover, certain of the unfluted points suggest the "unfluted Folsom" points of the Scharbauer site in Texas.[3]

Of the more randomly distributed points, differences in size are the most conspicuous, the length range extending from 1 to $4\frac{3}{16}$ inches. The majority, however, are between 2 and 3 inches long. In outline configuration the nearly parallel-sided form greatly predominates (plates 1A, B, figures F,f, G,g). Especially in the larger sizes, this point closely conforms with the established Clovis Fluted type, the most widely dispersed and perhaps the most ancient of the fluted point varieties.[4]

A generally congruent variant, described in table 1, as having slightly incurvate lower edges (plates 3A, B, figures E,e, F,f) may fall within the normal shape range of the Clovis type, as the product of deeper edge grinding,[5] or constitute an intermediate developmental form between the Clovis and Cumberland fluted category, best represented in the Southeast, but also found in Ohio and elsewhere.[6] The modified form of New York (plates 4A, B, figures D,d) and Ohio occurs at the Quad site,[7] where it seems indeed to be transitional into the exaggerated Cumberland form, with the latter's marked constriction of the lower edges and prominent, obliquely lateral "ears."

Finally, there is the pentagonal style (plates 1A, B, figures C,c, D,d) which, with parallel or insloping lower lateral edges, is a major form on such widely separated sites as Williamson in southeastern Virginia[8] and Reagen in northwestern Vermont (plate 15, figures I, J).

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[1]Byers, 1954, pp. 349–351.
[2]Ritchie, 1953, pp. 255–257.
[3]Wendorf, Krieger, Albritton and Stewart, 1955, pp. 48–49. Compare their illustration No. 19 on plate 16 with my plate 15, figures F, G, 7.
[4]Krieger, 1947, pp. 10–11. It is of interest to compare New York specimens shown on plates 1-3, for example, with the points accompanying the Naco, Ariz., mammoth, illustrated by Haury (1953) as figures 6 and 7.
[5]See, for example, figures 6, 7 f of Haury, 1953.
[6]Lewis, 1954; 1954*a*; Soday, 1954, nos. 42, 43; Shetrone, 1936, figure 1 (first 3 examples).
[7]Compare, for example, plates 3A, B, figures F,f and 4A, B, figures D,d, with figures 5-8 of Soday, 1954.
[8]McCary, 1951, figures 8, 2, 3, 12, 19–22.

In the present state of knowledge, distinctions of this kind cannot be interpreted on a functional, temporal or spatial basis. Nor can the antecedents or derivatives of the sundry forms be demonstrated with any degree of conviction. It has been suggested, as earlier mentioned, that people responsible for the Clovis Fluted type were primarily elephant hunters in the High Plains area during the maximum episode of Wisconsin time (Cary Subage?). Desiccation brought about by the progressive warmth and dryness of an interstadial period (Two Creeks?) may have provided the stimulus for their movement, following the big game, through a prairie corridor into the better watered eastern United States.[1] In the western area bison, better adapted to the increasing prairie conditions, furnished subsistence for the hunters who remained, and the smaller and lighter Folsom Fluted point seems to have been developed from a Clovis prototype (during the Mankato and/or Valders Subage?) as a more suitable weapon.

Adding to this speculation, the Clovis point users invaded first the more southerly regions of the eastern United States, via the aforementioned prairie corridor, avoiding the less salubrious climatic environment of the Northeast. Thinly spread and mobile in the new setting, the small groups responded to local ecological variations with innovations which apparently affected particularly the more critical elements of the cultural equipment, viz., the weapons of the basic hunting activity. Thus the more general uniformity of simple domestic tools—end and side scrapers, flake knives, gravers etc.—presumably derived from traditional Clovis prototypes, contrasts with range of point styles, some of which have already been described, and all of which are generically linked together in still undecipherable stylistic sequences by adherence to such cultural compulsives as fluting, basal edge grinding and certain pressure chipping techniques.

To conclude our assumptions, the Northeast became, in due course, included within the hunting range of the paleo-Indians, but whether before or after the fundamental Clovis industry had undergone various modifications in point styling it is impossible to say. The Shoop site seems to furnish the most satisfactory known evidence in the eastern United States for an occupation on or about the Clovis level in the Great Plains. If this assumption is correct, we still do not know what changes the Clovis industry may have undergone, both in the modification of fluted points and in associated artifacts, during east-

[1]Lewis, 1953, pp. 39–40; 1954. This author, however, postulates a movement in Altithermal times (ca. 5000–2000 B.C.), apparently too late, as shown above, to fit the newer evidence.

ward diffusion from the supposed center in the Great Plains. High traditional reserve is, however, indicated by the striking similarity of Clovis points throughout their known range from coast to coast.

The pre-Archaic age of the fluted point industries in the eastern United States is primarily based on comparative radiocarbon dates between Archaic components in the Northeast and Southeast, and a Folsom component in the Southwest.[1] Meager stratigraphic support came from the Carlson Annis site in Kentucky.[2] In New York[3] and Kentucky[4] Archaic cultures[5] were well established around 3500 B.C. and probably several centuries earlier. Groups of fishermen were building fish weirs on the Massachusetts coast at about the same time.[6] In all probability, most regions of the country were more or less sparsely peopled by 3500 B.C. with seminomadic hunting-fishing-gathering bands having cultural traditions partly derived in some cases from paleo-Indian antecedents, partly through later migrations from Asia. If confirmed by additional findings, the 7922 B.C. ± 392 years dating for Zone 1 at Modoc Rock Shelter, southwestern Illinois,[7] closes the temporal gap between paleo-Indian and Archaic manifestations,[8] and serves to support probable genetic relationships already alluded to. Moreover, non-fluted point, paleo-Indian assemblages of generally comparable antiquity, from Gypsum Cave, Nevada,[9] and Danger Cave, Utah,[10] suggest that important elements of Archaic lineages are to be sought elsewhere than in the Clovis-Folsom fluted point tradition. Notwithstanding these considerations, present evidence from the Northeast fails to connect typologically, recognized paleo-Indian with Early Archaic assemblages, thus creating a probable hiatus of unascertained magnitude, prior to the established 3500 B.C. radiocarbon date for the latter. It seems, there-

[1]Sample C 558, burned bison bone, 9,883 ± 350 years B.P. (Libby, 1955, p. 107). A more recently collected and measured sample of fresh-water snail shells from a higher level of the Folsom stratum at the same Lubbock, Texas site, yielded an age of 9300 ± 200 years, at the Lamont Laboratory (Krieger, 1956a, p. 107).

[2]Webb, 1950, pp. 307–310. The little known and unpublished St. 4 site in North Carolina is said to yield evidence of this kind (Witthoft, 1952, pp. 486–487).

[3]Libby, 1955, p. 93; Ritchie, 1951, p. 31.

[4]Libby, 1955, pp. 98–99, 105; Webb, 1951, p. 30.

[5]That is, preceramic and preagricultural assemblages containing polished stone artifacts, in addition to those of chipped stone, ground stone, bone, antler and sometimes shell.

[6]Libby, 1955, p. 90; Johnson, 1951, samples 417, 418, pp. 11–12.

[7]Fowler and Winters, 1956, pp. 31–32.

[8]I am not in agreement with the trend in some quarters to employ the term "Early Archaic" in reference to nonfluted point assemblages which may contain ground stone, shaped through use, as milling stones and manos, but which lack polished stone artifacts, which I regard as a primary criterion of the Archaic stage of culture.

[9]Libby, 1955, pp. 117–118; Harrington, 1933.

[10]Jennings, 1953.

fore, logical to project the paleo-Indian vestiges of this area to a chronological horizon sometime prior to 3500 B.C. Here the findings of Pleistocene geology, in furnishing certain still debatable details of late glacial and postglacial paleogeography, seem of some importance in suggesting at least a minimum time limitation for the paleo-Indian occupation of this area.

Thus, in plotting the beach line of the closing stage of Lake Iroquois, the most recent glacial body of water known to have existed in New York, against the principal district of concentration of fluted points in the State, it is readily seen that those portions of the Seneca River valley in Onondaga, Cayuga and Wayne Counties where fluted points have been found with highest frequency were uninhabitable at this stage, being submerged beneath the lake waters.[1] Similarly, the minor cluster of points at the foot of Lake George and about Ticonderoga on Lake Champlain occurs in a section inundated by the Fort Ann stage of glacial Lake Vermont,[2] which is believed to have coexisted with Lake Iroquois.[3] Moreover, the localities of many of the Ontario fluted points were then probably under either Lake Iroquois waters or the ice sheet which created it.[4] (See figure 1.)

Assuming the reliability of the geological data, it must be concluded that man's presence at these places was subsequent to the termination of the Lake Iroquois-Lake Vermont phase, provisionally inferred from radiocarbon dating of geological events at approximately 7,000 years age.[5]

By this time, it is believed, progressive amelioration of the climate had resulted in the stagnation and decay of the ice lobe partially overlying the Ontario basin and St. Lawrence Lowland to the extent of uncovering the northern slope of the Adirondack Mountains. A new low outlet channel for Lake Iroquois opened south of Covey Hill, just north of the International Boundary line, draining through the St. Lawrence Valley to the Champlain Lowland. The old drainage route through the Mohawk-Hudson channel was abandoned. Long enduring Lake Iroquois, with its prominent beach lines, came rather rapidly to an end.

Its considerably shrunken successor, known as Lake Frontenac, appears to have been short-lived, as indicated by feeble strand lines. With continuation of ice recession north of Covey Hill, the impounded Ontario basin waters dropped still lower, resulting in the

[1]Fairchild, 1919, pp. 61–62, plate 1; 1928, pp. 152–157, figure 147.
[2]Chapman, 1937, pp. 103–113, figure 4.
[3]Flint, 1953, plate 3; 1956, plate 1.
[4]Hough, 1953, figure 23.
[5]Flint, 1956, plate 1.

body of water named by Fairchild the Gilbert Gulf.[1] (See figure 2.) In the Watertown, N. Y., district, recent studies have established the present beach line elevations of these three successive lakes at approximately 745, 655 and 400 feet, respectively.[2]

Lake Frontenac was apparently coalescent with the closing phase of Lake Vermont in the Champlain Lowland.[3] When progressive deglaciation had freed the local ice cap damming the St. Lawrence Valley in the Parc des Laurentides district of Quebec, an entry for marine waters was created, since the glacially depressed crust over the St. Lawrence-Champlain area lay far below the rising sea level. The invasion of salt water which followed created the Champlain Sea, reaching south to Whitehall in the Champlain Lowland and southwestward in the St. Lawrence Lowland to about Ogdensburg.[4]

In naming Gilbert Gulf, Fairchild had assumed that this marine incursion had extended into the Ontario basin. More recently it has been concluded that the volume of outflow from the Ontario basin sufficed to prevent the marine transgression west of Ogdensburg.[5]

The sands and clays attributed to the Champlain Sea stage yield cold water Mollusca, although it might appear that the climate at this time, estimated at around 6,000 to 7,000 years ago,[6] was approaching the Altithermal climax of warmth and dryness.[7] Champlain Sea strand lines are very imperfectly known and there is no general agreement on the subject (figure 2).[8] It does seem, however, that most fluted point finds in New York occur in places above the probable reach of these sea waters, the only exceptions being at Cedar Point, Jefferson County; possibly near De Peyster, St. Lawrence County and the

[1]Fairchild, 1928, pp. 159–164.

[2]Stewart, n.d.

[3]Flint, 1956, plate 1.

[4]Flint, 1947, p. 263; 1953, pp. 909–10, 915, plate 3; Chapman, 1937, pp. 113–16, figure 5; Woodworth, 1905, pp. 206–45; Leverett and Taylor, 1915, p. 333.

[5]Stewart, n.d.

[6]Flint, 1953, p. 910, plate 3; 1956, pp. 272, 278–279. There is much uncertainty about the date of the Champlain Sea. Three C^{14} measurements on *Saxicava, Macoma* and *Balanus* fossil pelecypod shells range from 10,630 ± 330 to 11,370 ± 360 years old, which would approximately equate this marine submergence with the Two Creek interval, just prior to the Mankato and/or Valders advance (Preston, Person and Deevey, 1955, p. 56). These results have been questioned on the grounds that the animals, living in calcareous waters carrying carbon from Ordovician, Cambrian and Precambrian formations, could build into their shells not only contemporaneous carbon but also ancient carbon "and until we can find out the proportion of ancient carbon to contemporaneous carbon, the dating of buried shells by radiocarbon has no meaning." (Personal communication of February 23, 1956, from Professor Paul MacClintock, Princeton University. Cf. discussion in Flint, 1956, p. 278.)

[7]Antevs, 1953, p. 204, and figure 1; 1953*a*, p. 11.

[8]Hough, 1953, figure 25.

locale about Ticonderoga and the northern end of Lake George (figure 2 and table 1). Moreover, the artifacts of the Reagen site occur in dunes of sand attributed to the maximum stage of the Champlain Sea.[1] The peculiar location of this station, on the flank of a hill, overlooking the Missisquoi River in Franklin County, Vermont, from an elevation of some 300 feet, a situation wholly at variance with later Indian cultures of the area, suggests the possibility of a near-shore camping place, repeatedly visited, during a waning stage of the Champlain Sea.

Let us suppose that the 5000 B.C. date for the early existence of the Champlain Sea approximates reality. The paleo-Indian hunters whose meager vestiges are found within the probable extreme confines of this sea—in the St. Lawrence-Champlain Lowland and at the Reagen site—must have been still more recent. Moreover, by the same tentatively established chronology, only a few additional centuries separate the early Champlain Sea from the period of late Lake Iroquois and the Fort Ann stage of Lake Vermont, within whose basins have been found some 41 percent of the fluted points from New York State. These data argue strongly for the recency of paleo-Indian hunters in the Northeast, although current evidence does not prejudice the possibility of greater antiquity for similar remains immediately south of these barriers.

Much more reliable lower time estimates from radiocarbon dated components place the Early Archaic Lamoka culture in southcentral New York at around, 3500 B.C. and the contact of Lamoka and Laurentian groups in central New York about 500 years later.[2] As already mentioned, indications of continuity or contact between Archaic and paleo-Indian groups in this area are negligible. It would therefore seem that our conclusions, based upon quantitative considerations and geologic factors, point in the direction of a scanty occupation by paleo-Indian hunters in the Northeast during a relatively brief and recent interval falling somewhere between approximately 3500 and 5000 B.C.

[1]Lougee, 1953, p. 275.
[2]Libby, 1955, pp. 92–93; Ritchie, 1951, p. 31.

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PLATES

Plates 1A and 1B

Fluted points from New York

A, a(1)*, Onondaga County
B, b(2), Seneca River
C, c(3), Seneca River
D, d(4), Seneca River
E, e(5), Onondaga County
F, f(6), Coxsackie, Greene County
G, g(7), Colliersville, Otsego County
H, h(8), Coxsackie, Greene County
I, i(9), Cross Lake, Onondaga County

* Numeral designations throughout plate captions refer to numbers in first column of table 1, which presents other available data on the specimens.

PLATE 1A

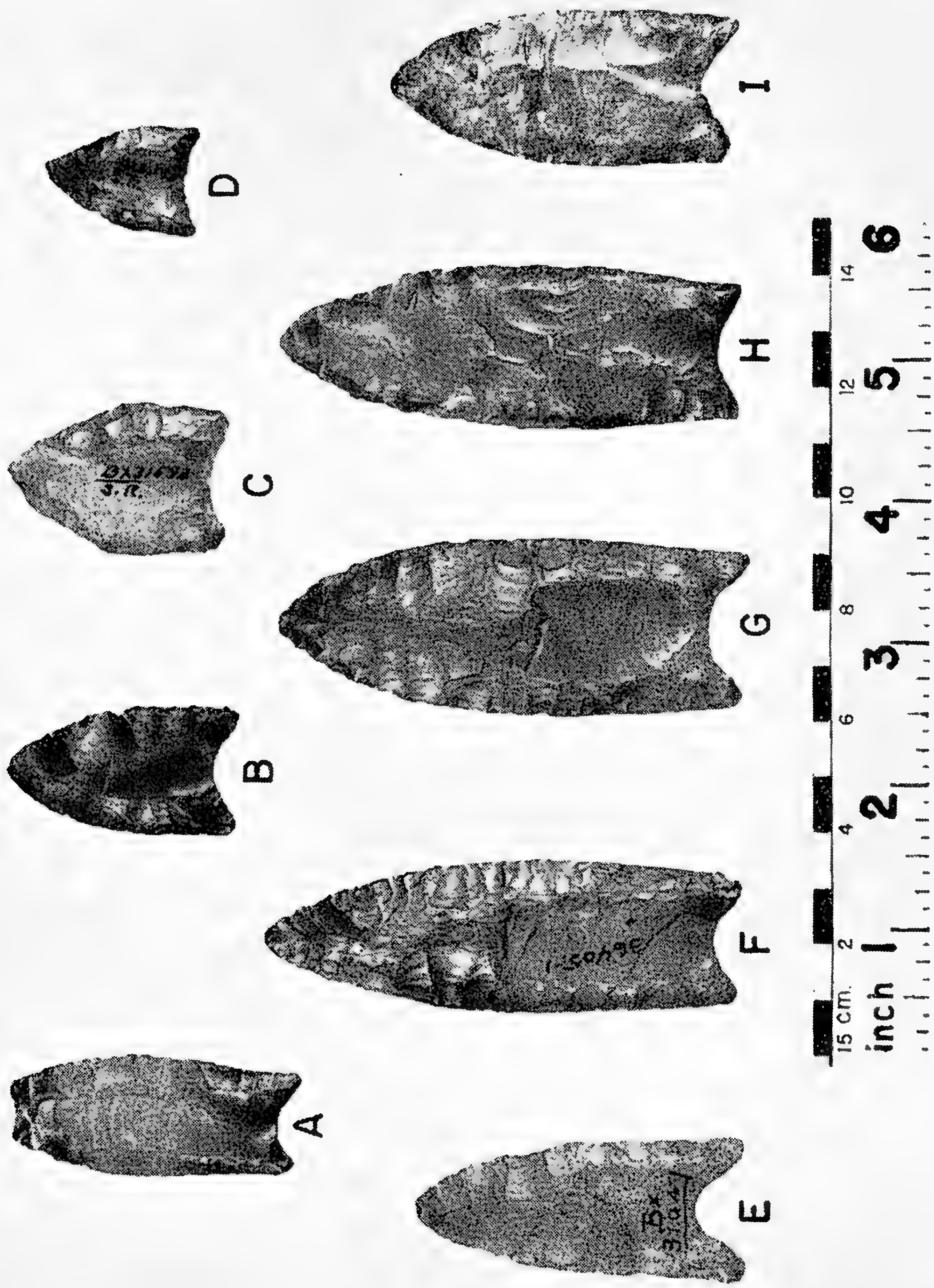


PLATE 1B

PLATES 2A and 2B

Fluted points from New York

A, a(10), Nichols Pond, Madison County
B, b(11), West Albany, Albany County
C, c(12), Deer River, Lewis County

D, d(13), Onondaga County
E, e(14), middle Genesee Valley
F, f(15), Onondaga County

G, g(16), Jefferson County

PLATE 2A

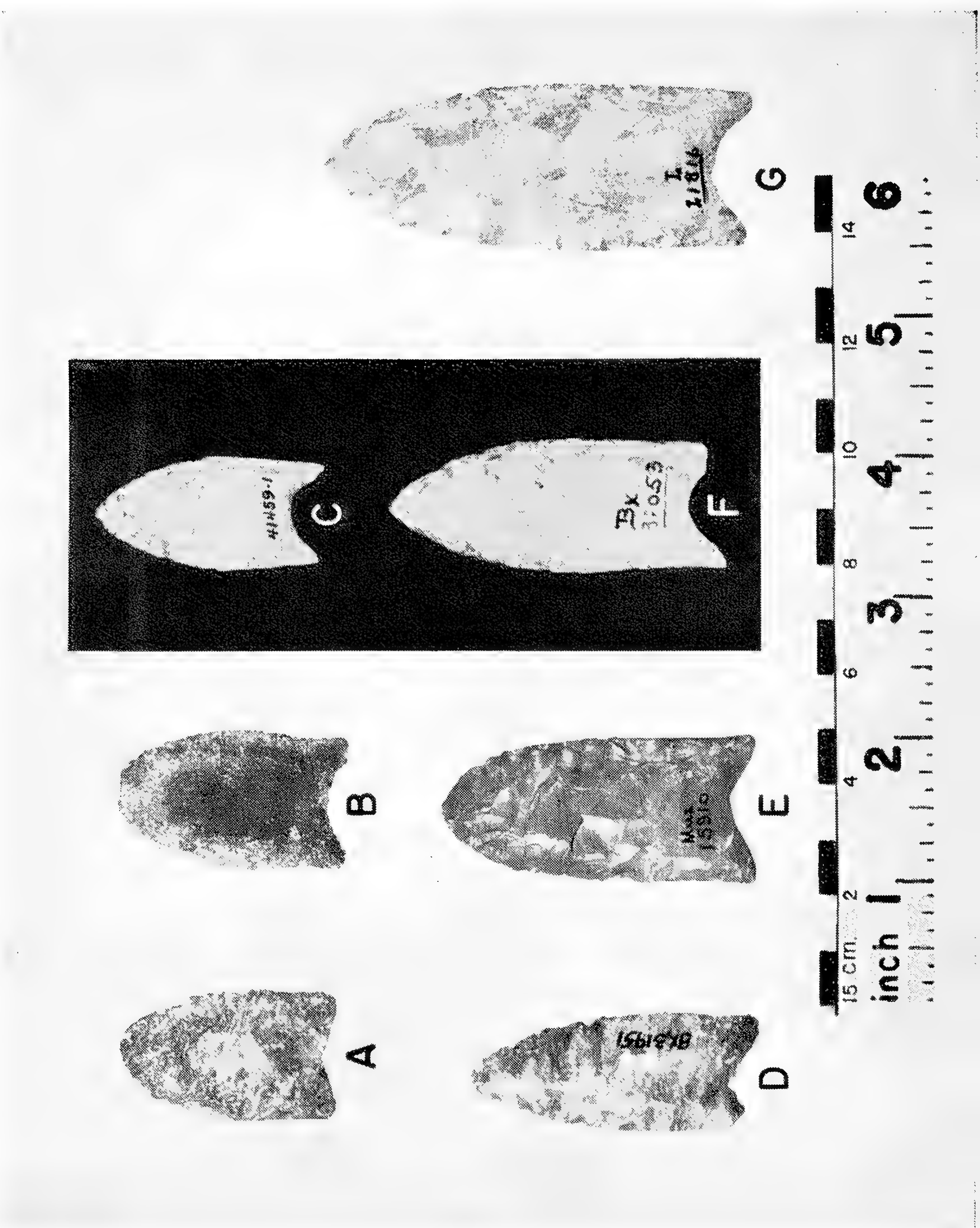
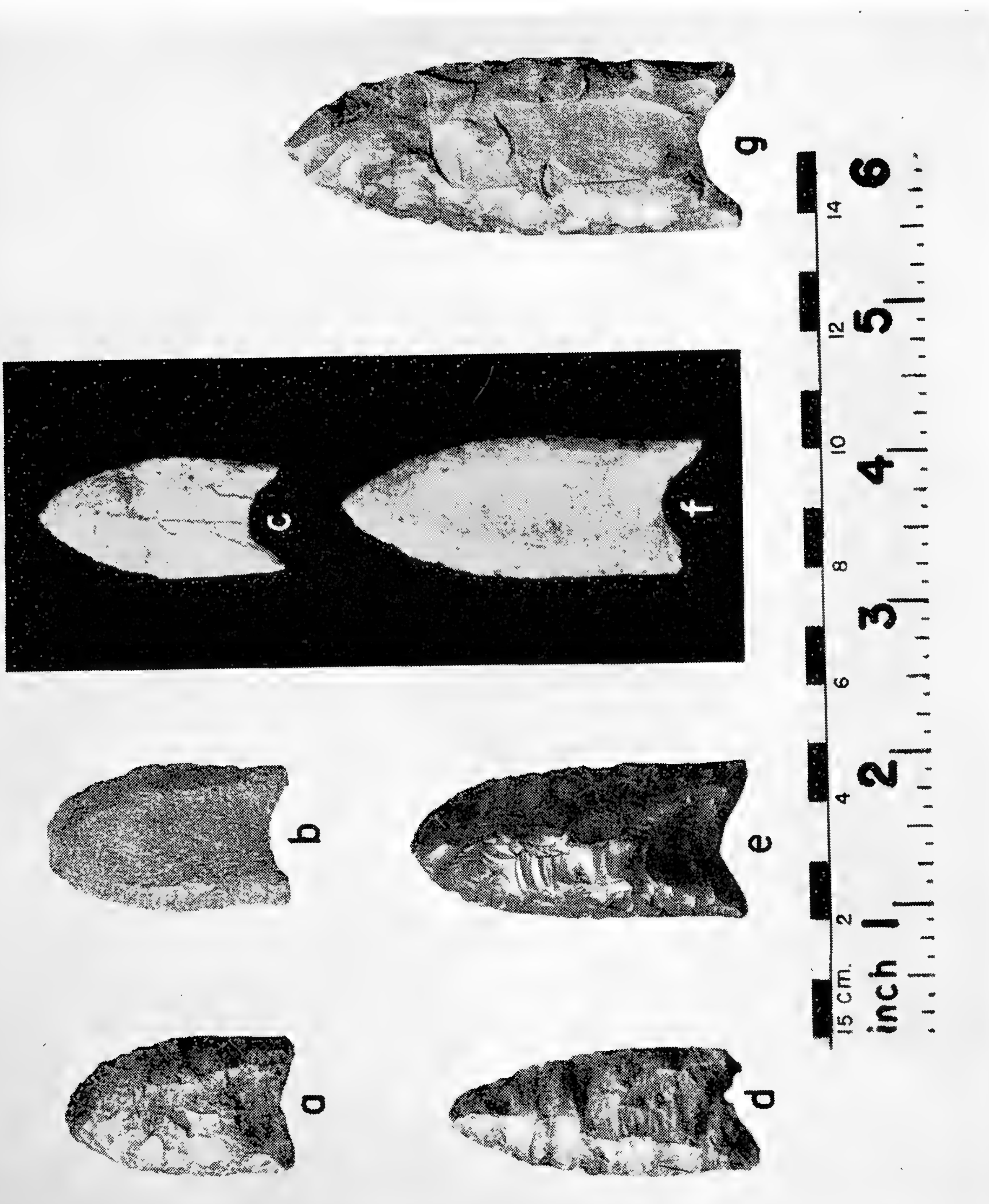


PLATE 2B



PLATES 3A and 3B

Fluted points from New York

A, a(17), Onondaga County
B, b(18), Jefferson County
C, c(19), Coxsackie, Greene County

D, d(20), Onondaga County
E, e(21), Bacon Hill, Saratoga County
F, f(22), Kingston Point, Ulster County

PLATE 3A

PLATE 3B

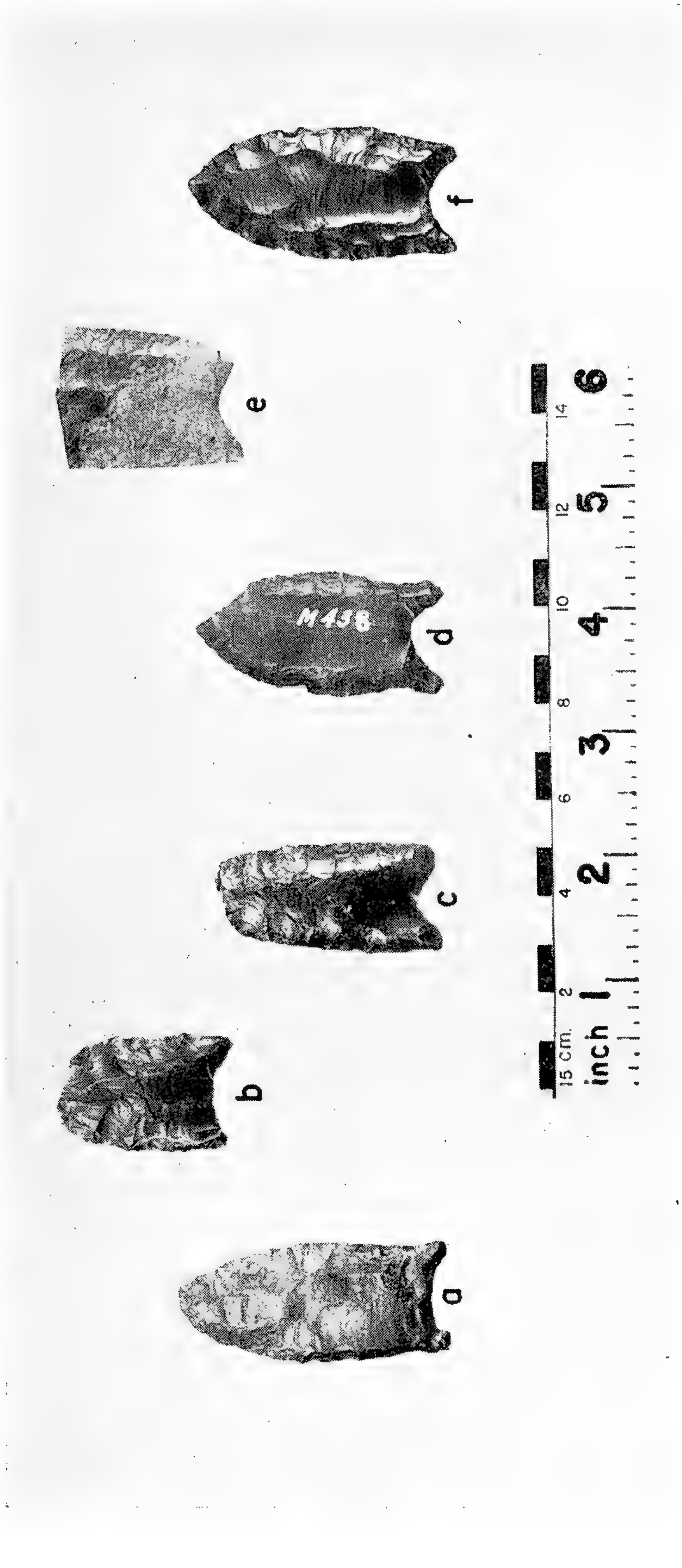
PLATES 4A and 4B

Fluted points from New York

A, a(23), near Wallkill, Ulster County
B, b(24), near Allard's Corners, Orange County
C, c(25), near Allard's Corners, Orange County
D, d(26), Canadarago Lake, Otsego County
E, e(27), Oaks Creek, Otsego County
F, f(28), Mud Lake, St. Lawrence County

PLATE 4A

PLATE 4B



PLATES 5A and 5B

Fluted points from New York

A, a(29), near Pittsford, Monroe County
B, b(30), near Macedon, Wayne County
C, c(31), lower Genesee Valley
D, d(32), near Baldwinsville, Onondaga County
E, e(33), Canandaigua Lake, Yates County

PLATE 5A

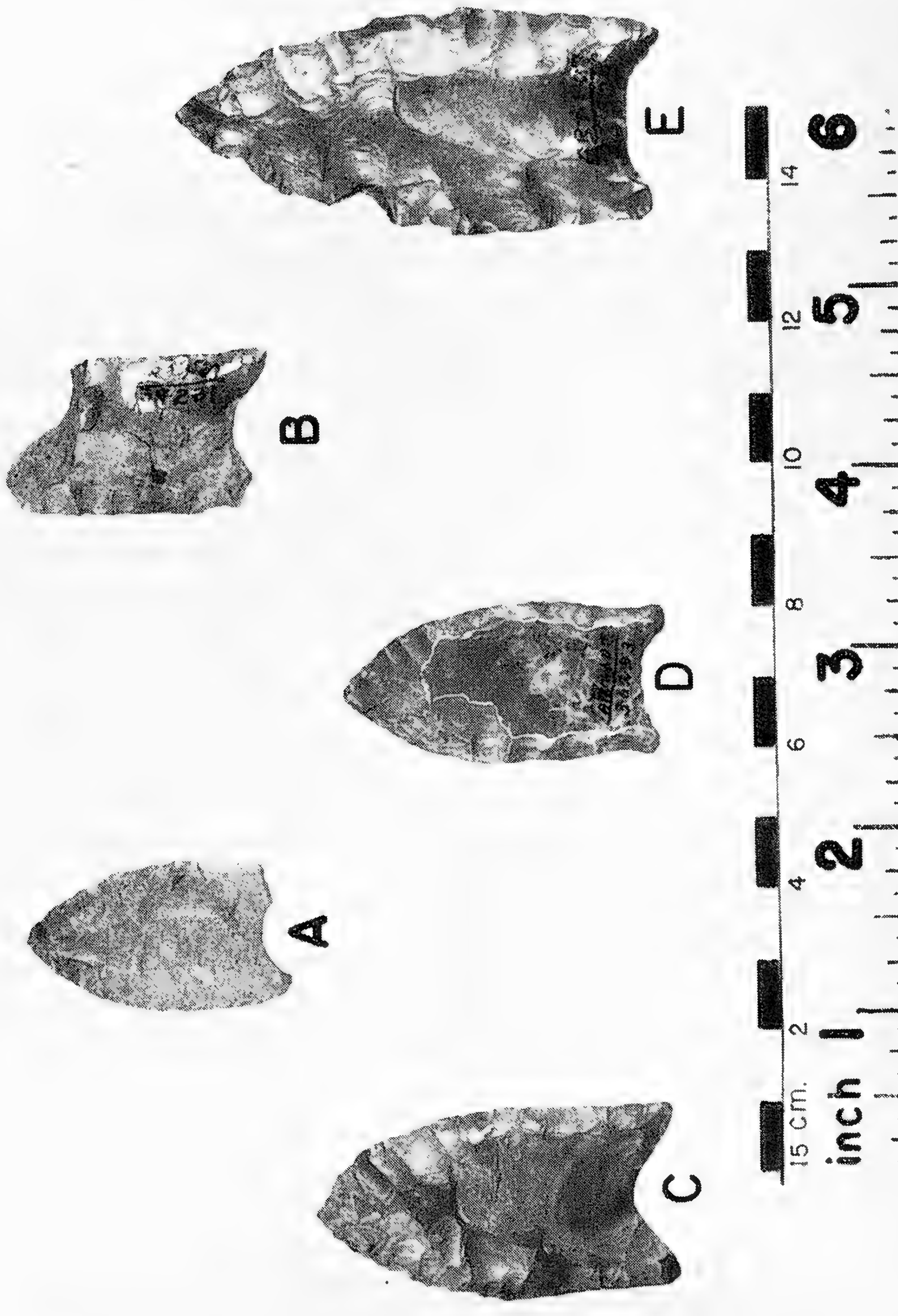


PLATE 5B

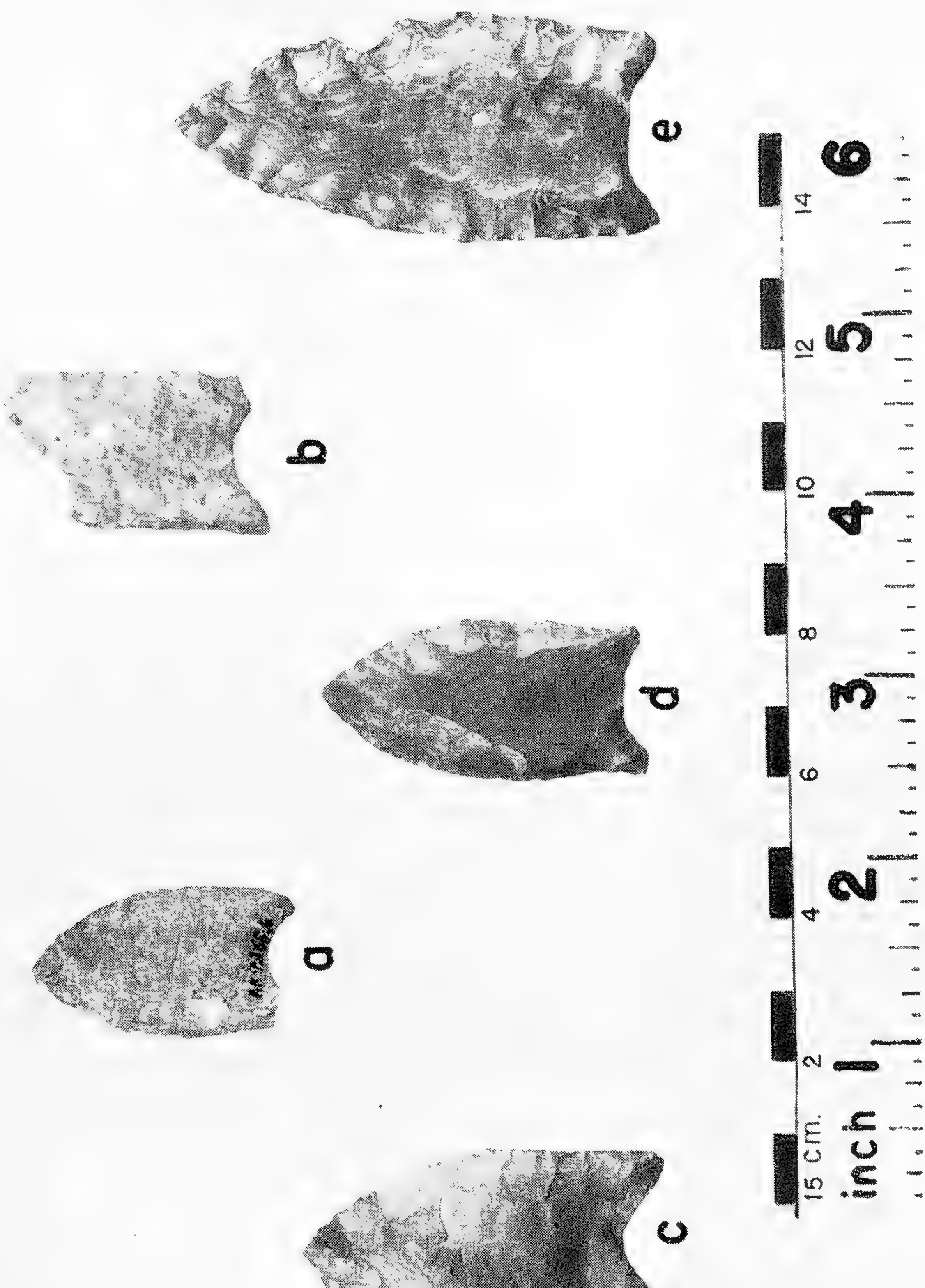


PLATE 6

Fluted points from New York

A (34), Onondaga County
B (35), near Greece, Monroe County
C (36), Onondaga County
D (37), Onondaga County

PLATE 6

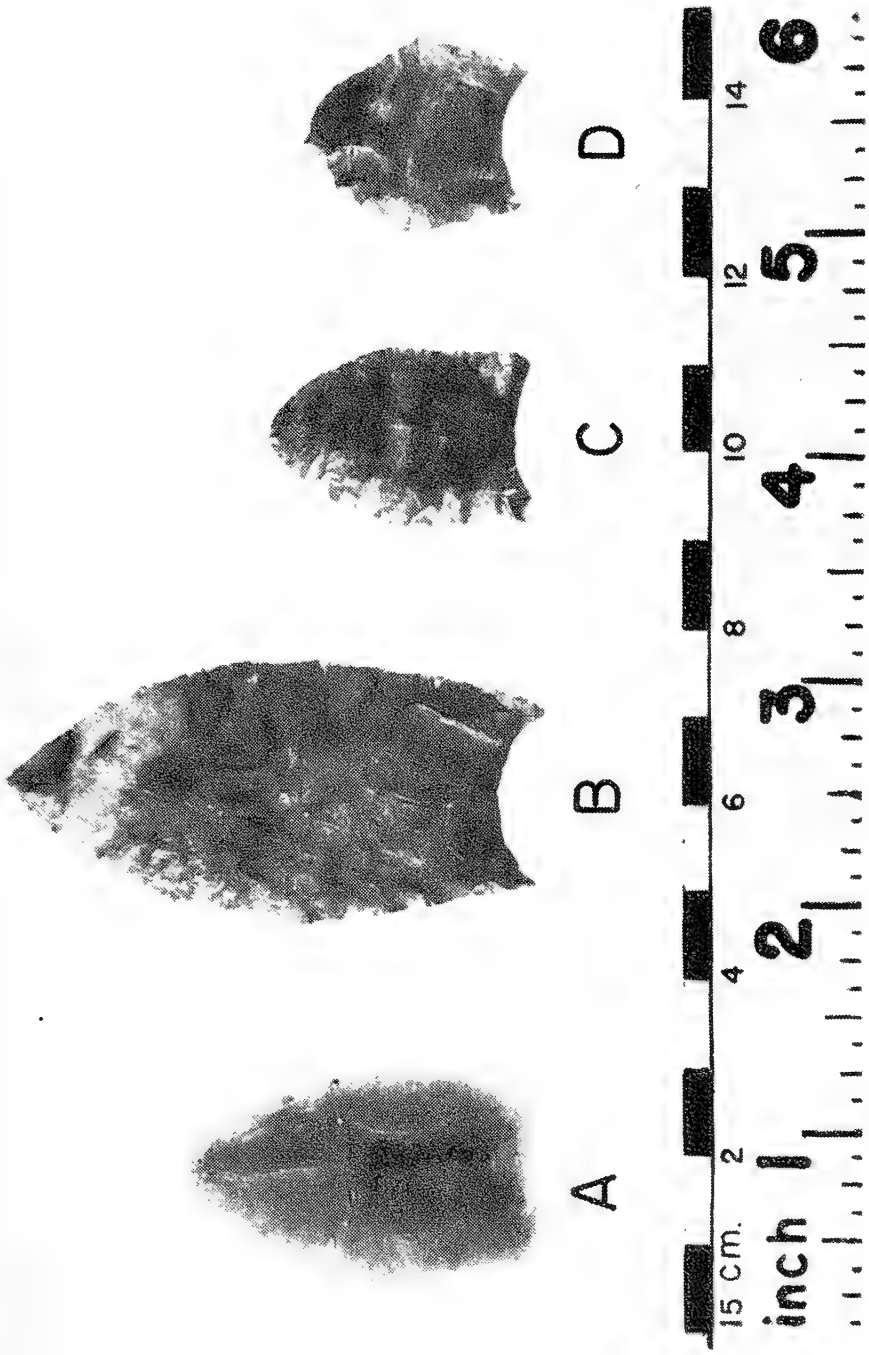


PLATE 7

Fluted points from New York

A, a(38), near Walcott, Wayne County
B (39), near Montezuma, Cayuga County
C, c(40), near North Rose, Wayne County
D, d(41), near North Rose, Wayne County
E, e(42), near Horseheads, Chemung County

PLATE 7

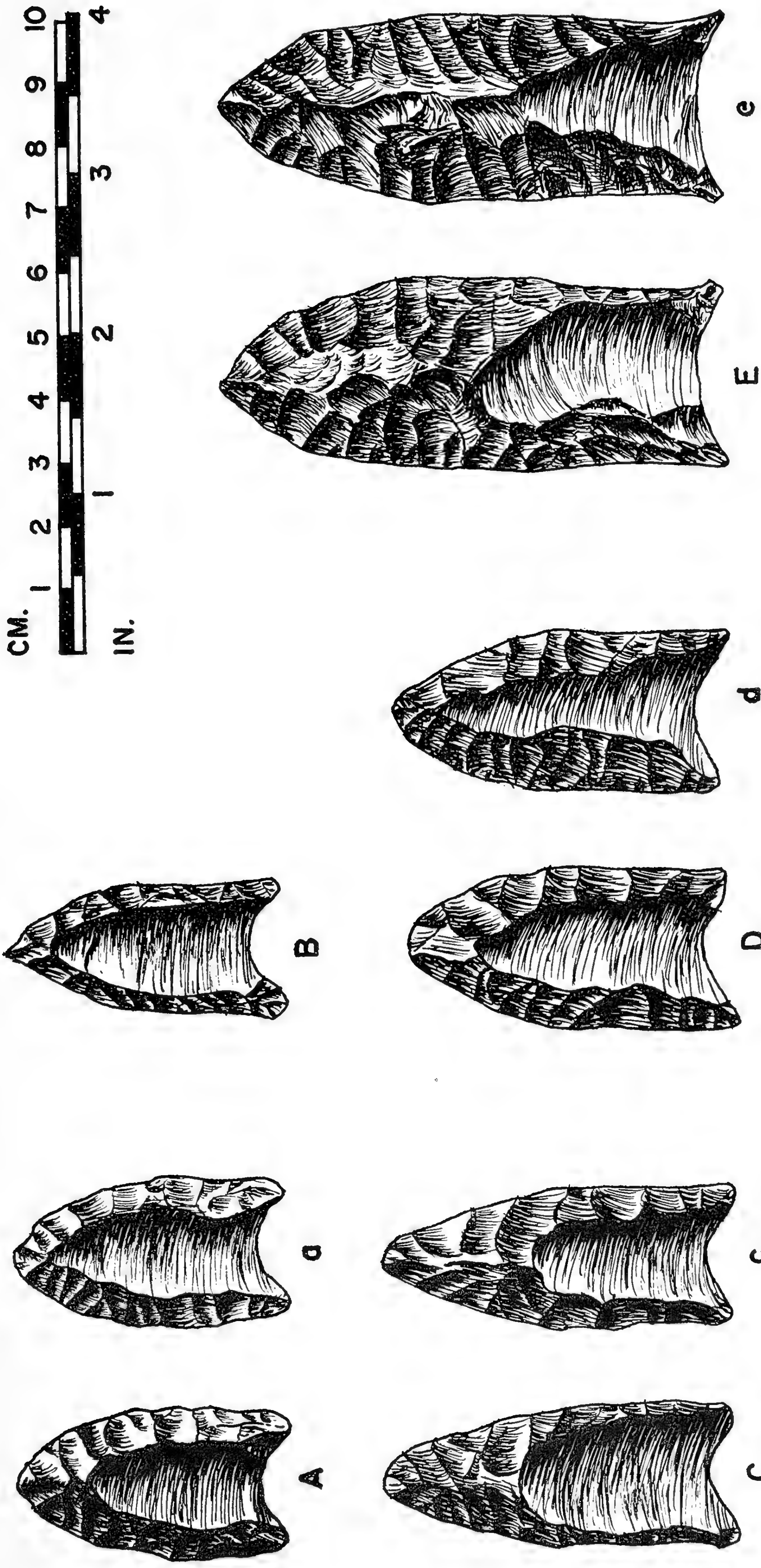


PLATE 8

Fluted points from Cornell University campus, Tompkins County

A, a(43), length is 2¼ inches B, b(44)

Photograph by courtesy of Smithsonian Institution.

PLATE 8

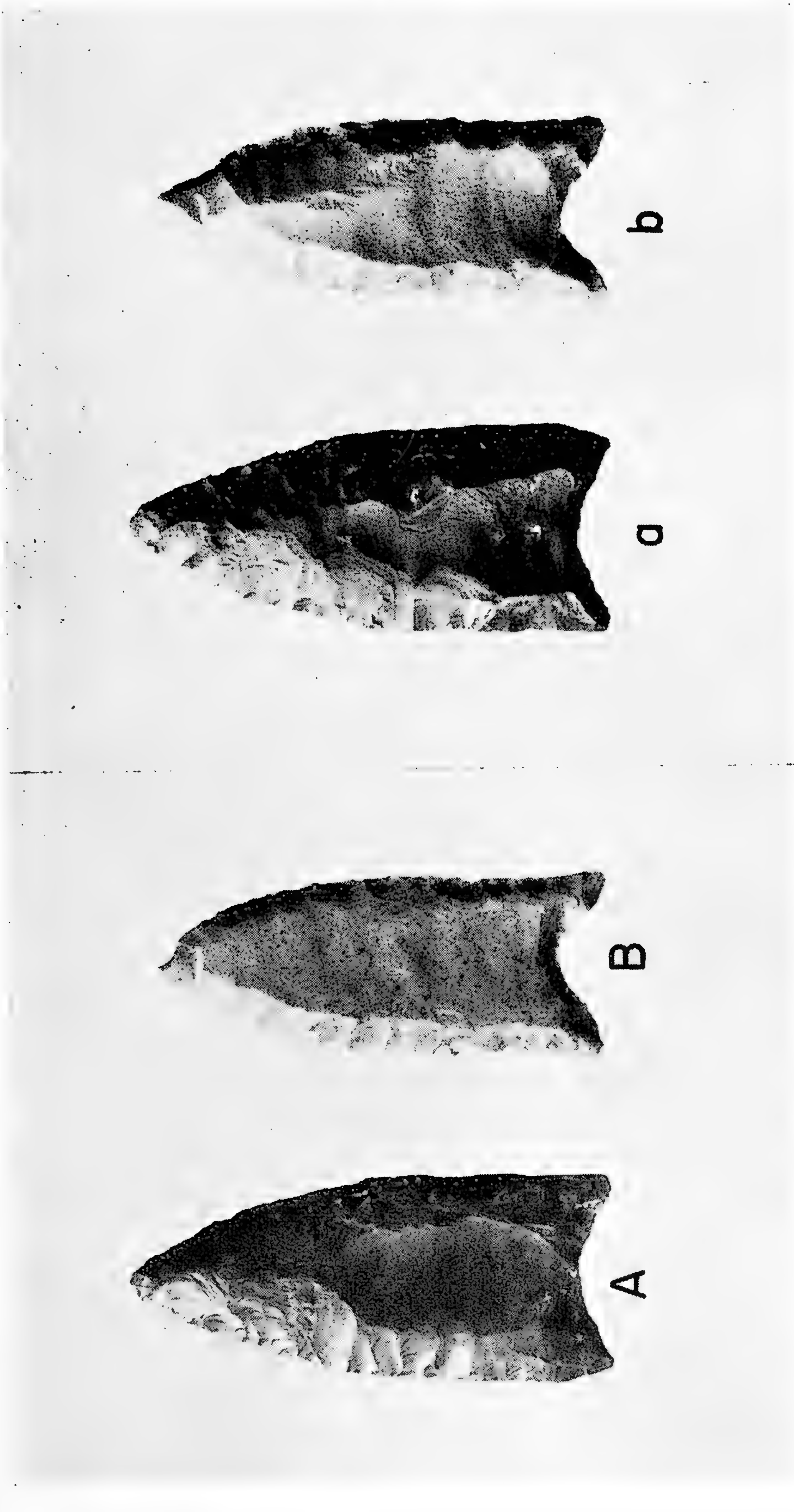


PLATE 9

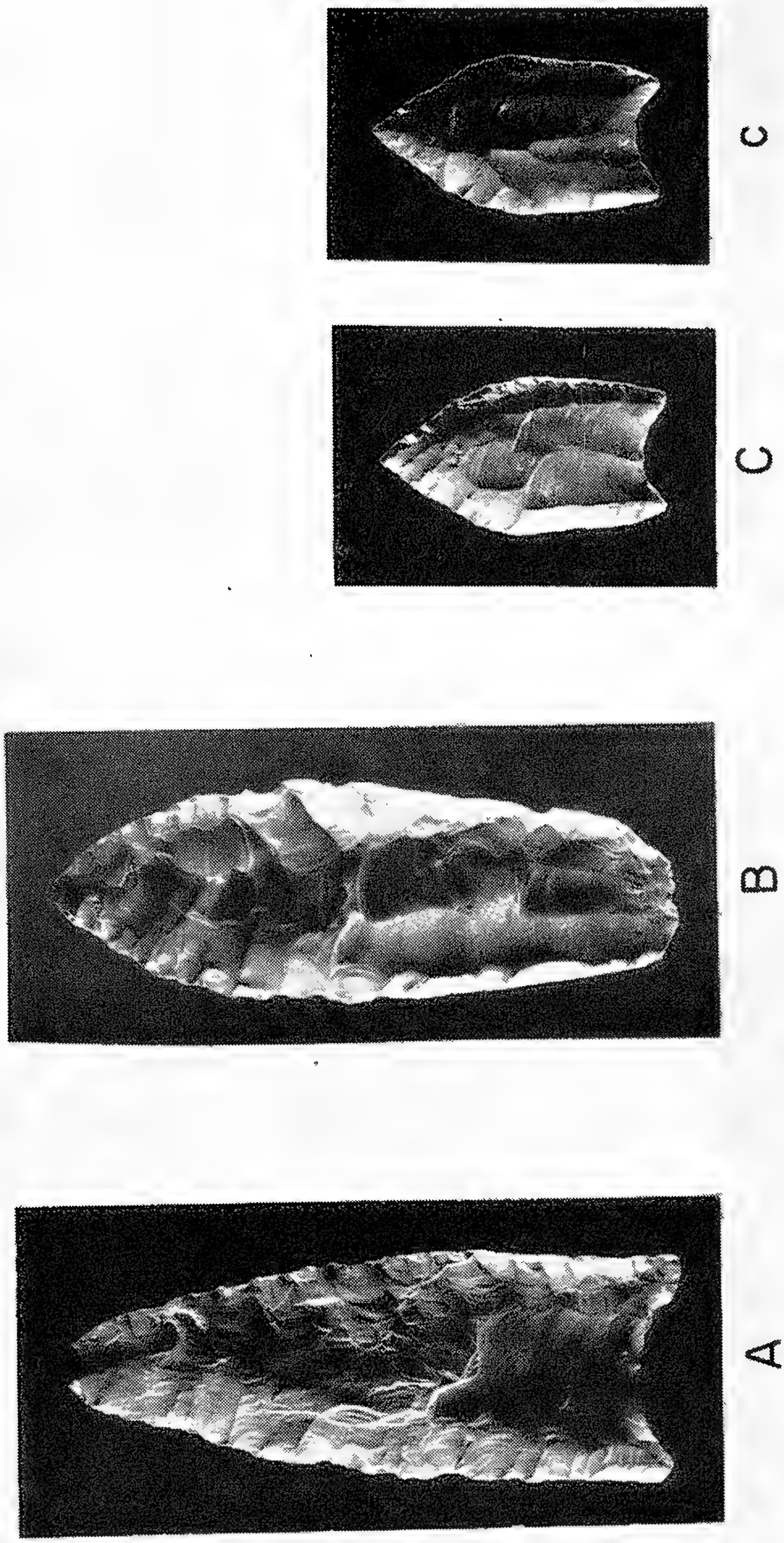
Fluted points from New York

A (45), near Nichols, Tioga County B (46), near Nichols, Tioga County

C, c(47), Binghamton, Broome County

Length of A is $2\frac{5}{8}$ inches; of B, $3\frac{3}{8}$ inches; of C, $1\frac{1}{2}$ inches.

PLATE 9



PLATES 10A and 10B

Fluted points from New York

A, a(48), near Lawtons, Erie County
B, b(49), near Gowanda, Erie County
C, c(50), near Busti, Chautauqua County
D, d(51), near Bridgehampton, Suffolk County
E, e(52), Greenport, Suffolk County

PLATE 10A

PLATE 10B

Plate 11

Artifacts of red jasper from West Albany

A, combined spokeshave scraper and graver from uniface flake
B, knife or side scraper from thick uniface flake
C, small side scraper from uniface flake. Upper end (arrow) blunted as from use for fire-striker.

All were found within small blowout on sand ridge along brook comprising upper south feeder of Sand Creek, about 3½ miles west of Hudson River, Albany County, by Carl Sundler, West Albany. Fluted point shown in plates 2A, B, figures B,b, were found by Mr. Sundler under similar conditions, about three-quarters of a mile northeast.

PLATE 11

PLATE 12

Artifacts from the Reagen component, Franklin County, Vermont

Simple end scrapers (A-G, L-W, BB-HH) and stemmed end scrapers (H-K, X-AA, II-KK).

Materials: A, C, D, gray flint; E-G, P-R, T, U, W, Y, Z, FF, HH, rhyolite; H-K, L, N, O, AA, CC-EE, JJ, KK, banded black and grayish brown flint; B, black flint; M, X, BB, II, gray Onondaga (?) flint; S, V, GG, quartzite.

Collections of William A. Ross and Benjamin W. Fisher, St. Albans, Vermont.

PLATE 12

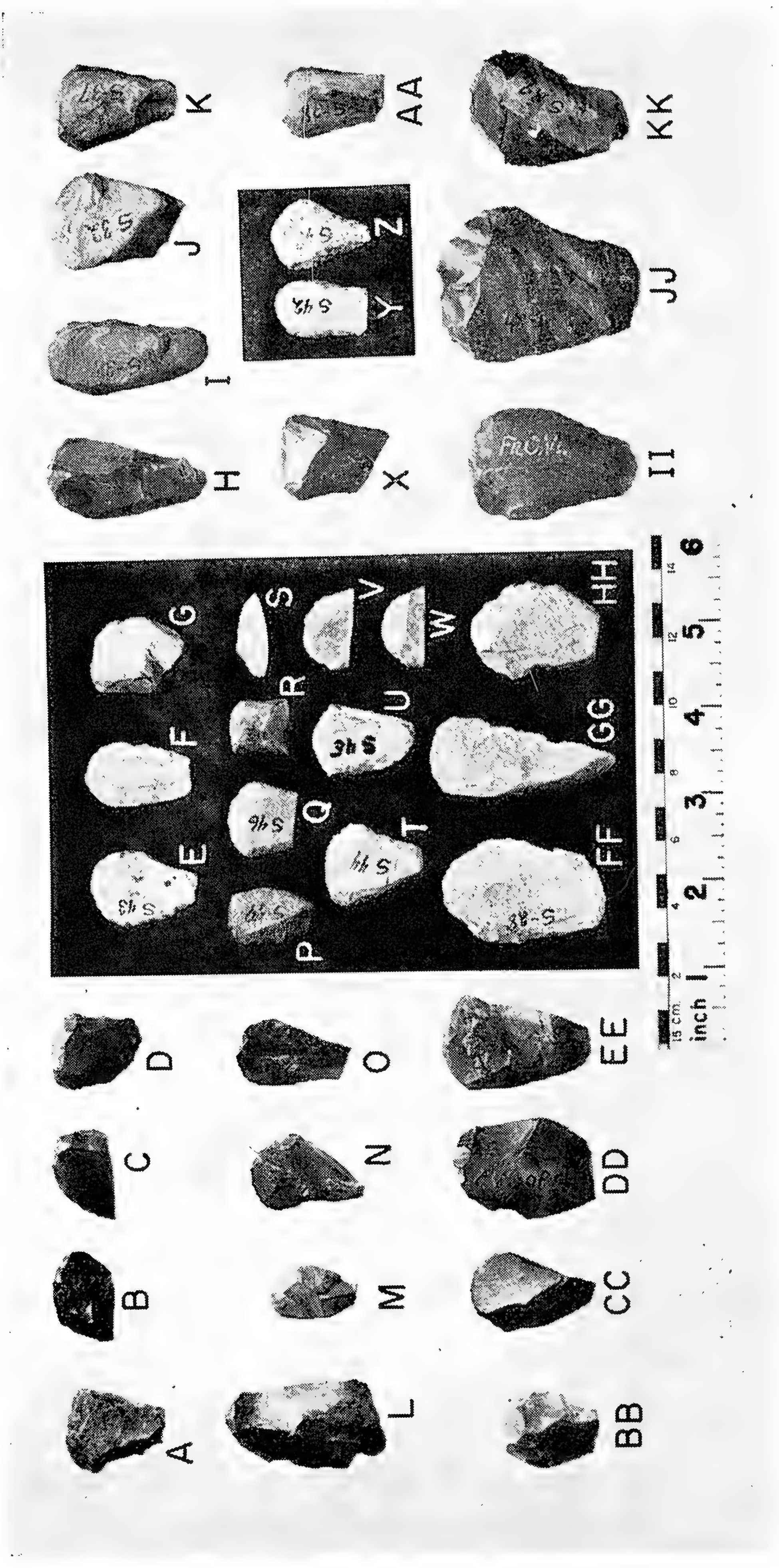

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PLATE 13

Artifacts from the Reagen component, Franklin County, Vermont

Simple end scrapers (A, B), side scrapers (C-Z, AA-GG), combined multiple graver (2 points) and spokeshave scraper (HH).

Materials: A, B, FF, gray flint; F, K-P, R, rhyolite; C, E, G, J, W-BB, EE, GG, banded black and grayish brown flint; V, DD, HH, black flint; U, CC, trap rock; Q, yellow jasper.

Collections of William A. Ross and Benjamin W. Fisher, St. Albans, Vermont.

PLATE 13

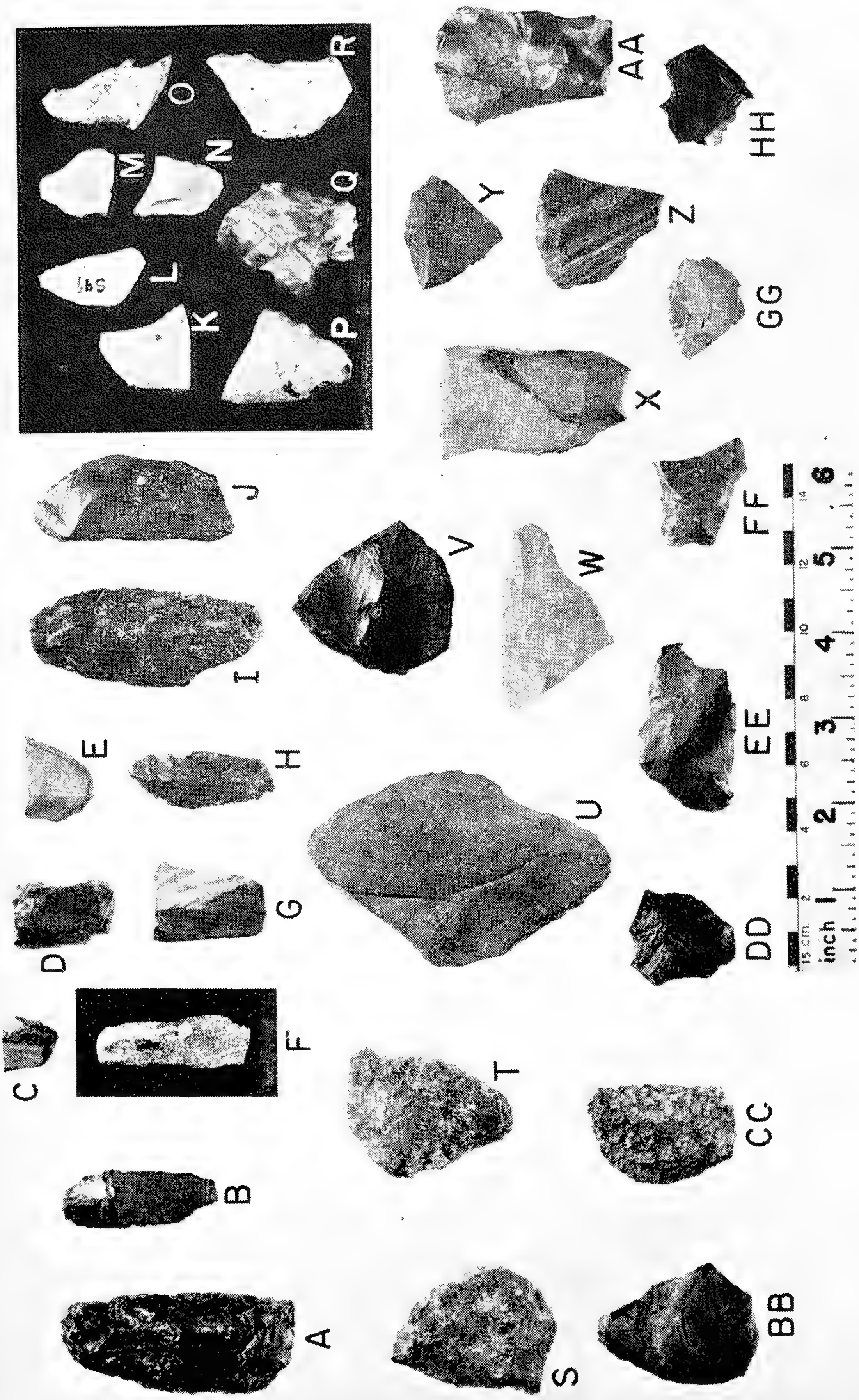
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PLATE 14

Retouched flake knives from the Reagen component, Franklin County, Vermont

Materials: C, gray flint; all others banded black and grayish brown flint.

Collections of William A. Ross and Benjamin W. Fisher, St. Albans, Vermont.

PLATE 14

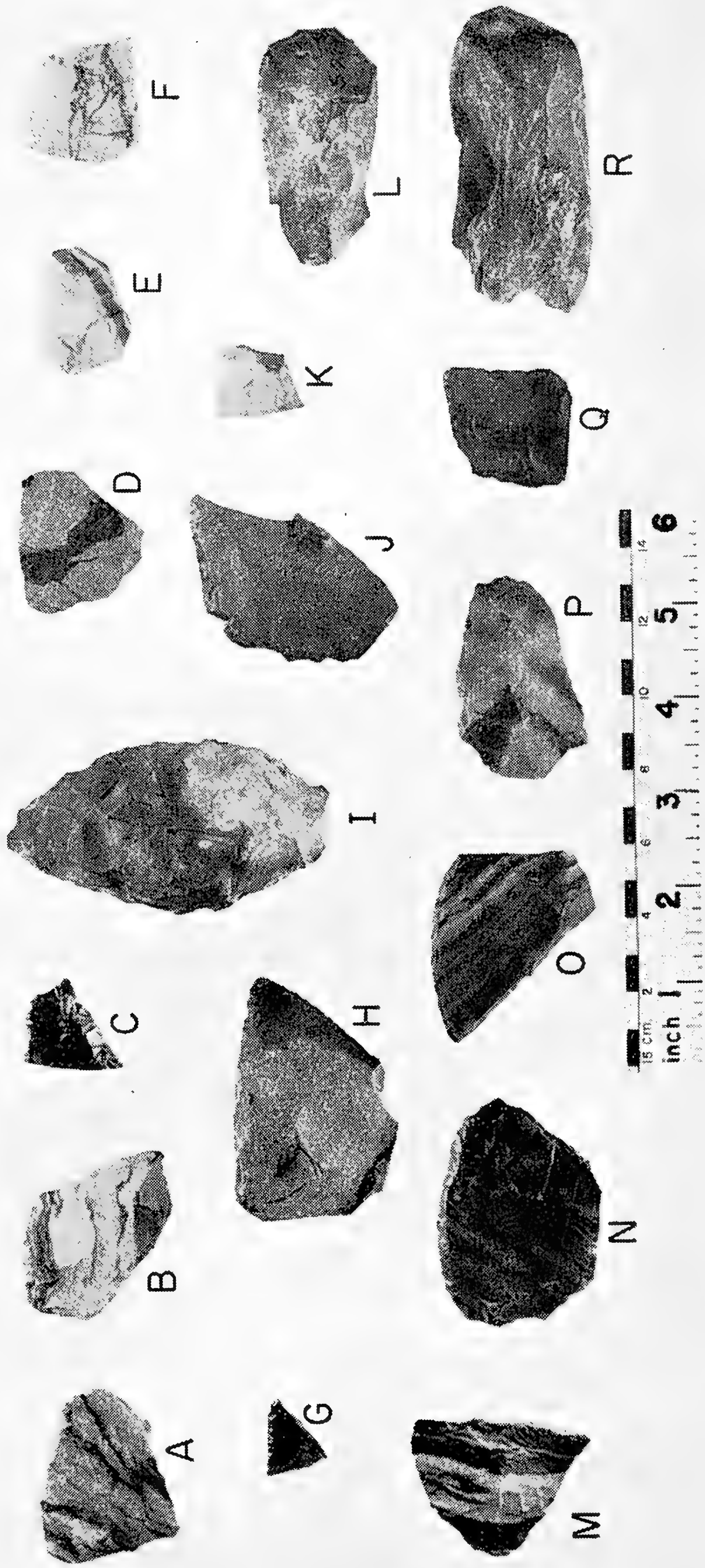

PLATE 15

Artifacts from the Reagen component, Franklin County, Vermont

Points of lanceolate pentagonoid form (A-J), E, H, I, J, are fluted; eared triangular points (K, L); trianguloid points (M, N, W-Z, AA, BB); point of pentagonal form (O); basal sections of points probably of lanceolate form (T-V, JJ-LL), U is fluted; points of slightly stemmed form (P-S); fragmentary points, base missing (MM, NN); unique ornaments, probably pendants (CC-II), CC and HH have rubbed channels, suggesting transfer of fluting trait from points.

Materials: B-E, K, R, S, AA, JJ-LL, MM, gray flint; L, N, Q, X-Z, rhyolite; A, M, U, black flint; F, mottled greenish black and white flint; G, brown flint; H, creamy chalcedony; I, V, mottled gray and brown Onondaga (?) flint; J, greenish gray flint; T, banded greenish gray and white flint; O, W, BB, trap rock; P, quartzite; NN, yellow jasper; CC-II, talc.

Collections of William A. Ross and Benjamin W. Fisher, St. Albans, Vermont.

PLATE 15

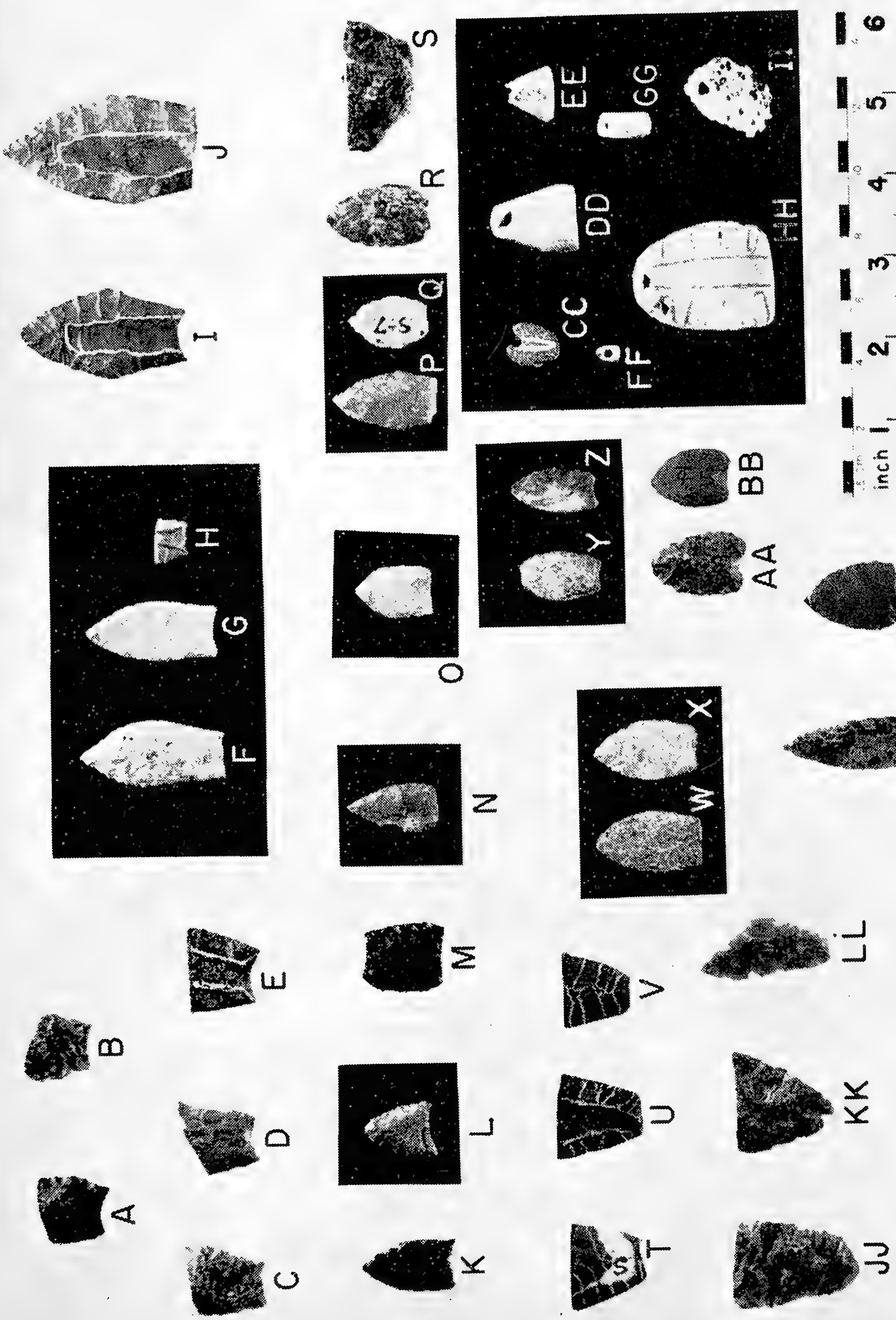
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PLATE 16

Artifacts from the Reagen component, Franklin County, Vermont

Indeterminate objects (A-E); lanceolate knives (F, H, K); knives with single shoulder (G, I, J, M, N); ovate knife (L).

Materials: A, B, J, M, gray flint; C, F-I, K, N, banded black and grayish brown flint; D, L, black flint; E, rhyolite.

Collections of William A. Ross and Benjamin W. Fisher, St. Albans, Vermont.

PLATE 16

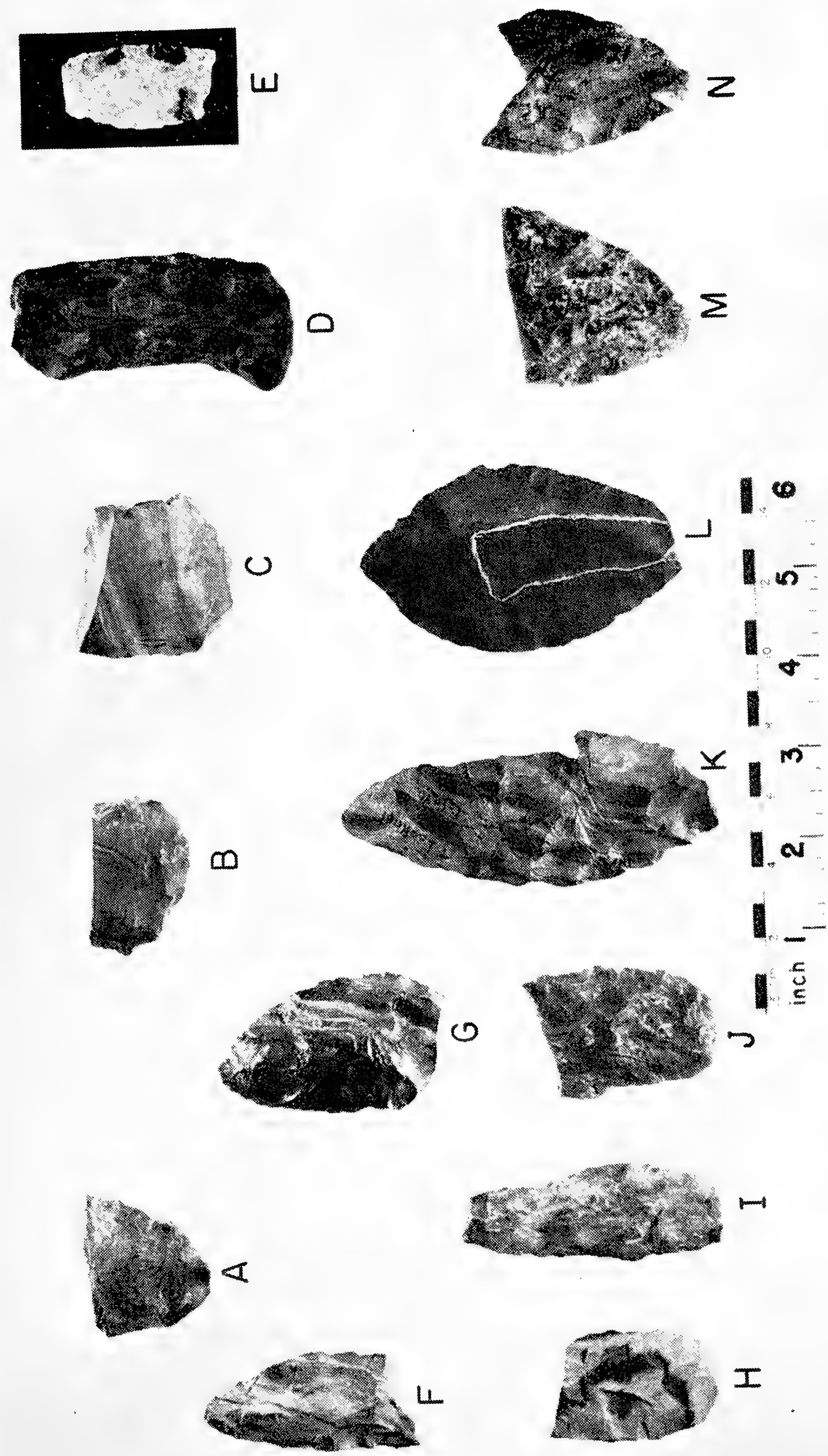

PLATE 17

Artifacts from the Reagen component, Franklin County, Vermont

Simple end scrapers (A, B); stemmed end scrapers (C-G); double spokeshave scraper (H); fragmentary ornaments, probably pendants (I-L); knife of single shoulder form (M); point fragment (N); trianguloid point (O); unretouched prismatic flake knife (P); combined multiple graver (3 points), spokeshave scraper and knife (Q).

Materials: F, O, gray flint; D, E, G, P, banded black and grayish brown flint; A, black flint; H, brownish gray flint; Q, gray Onondaga (?) flint; B, C, N, rhyolite; M, trap rock; I-L, talc.

Collection of Benjamin W. Fisher, St. Albans, Vermont.

PLATE 17

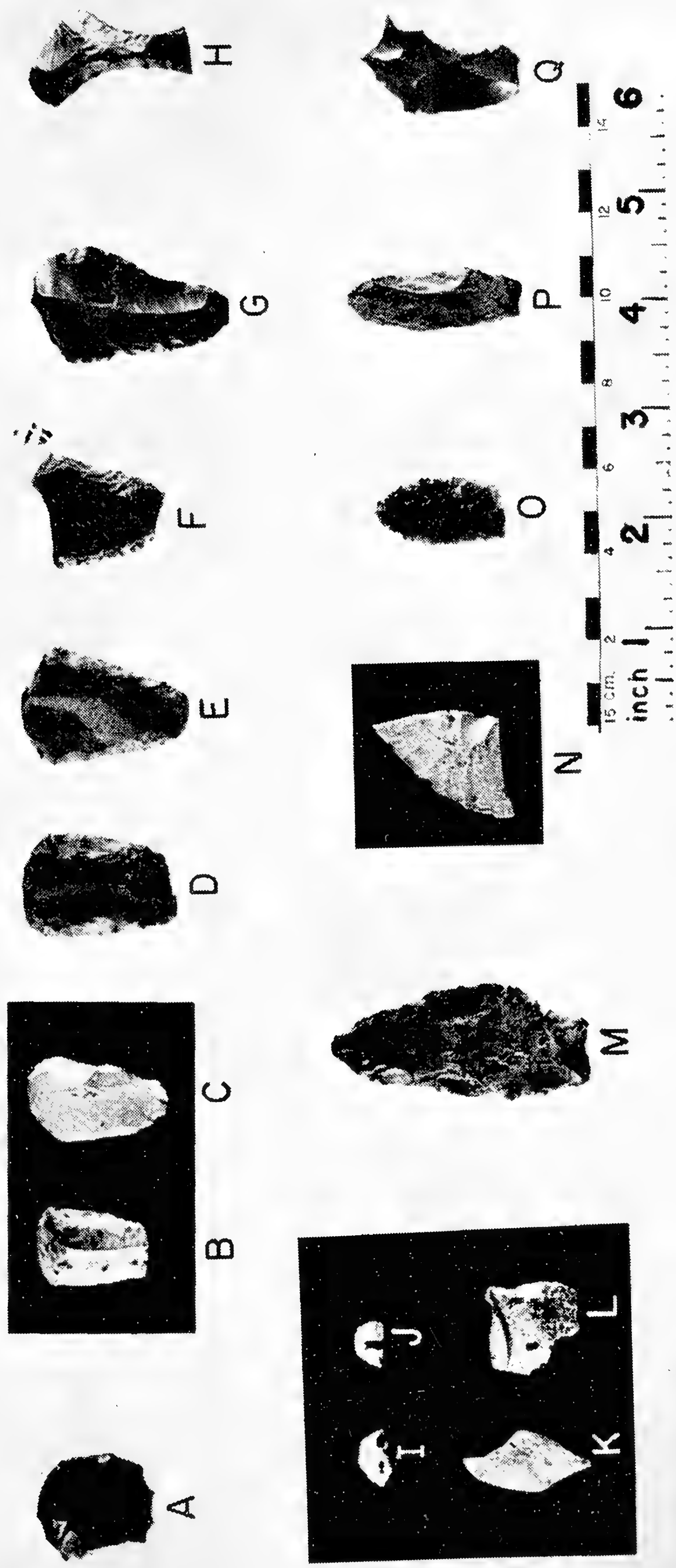

Plate 18

Artifacts from the Reagen component, Franklin County, Vermont

Basal fragments, probably of lanceolate points (A-D, H-J); lanceolate pentagonoid point (O), and fragments probably of this form (E-G, K-N, P), M and N have fluted bases.

Materials: E, gray flint; C, D, F, black flint; I, O, banded black and grayish brown flint; H, brownish gray flint; B, G, J, gray Onondaga (?) flint; A, L, K, N, rhyolite; M, quartzite; P, trap rock.

Collection of Benjamin W. Fisher, St. Albans, Vermont.

Note: Plates 12-18 illustrate the total series of artifacts from the Reagen component, of which a selection was published in Ritchie, 1953, figure 89. The artifacts shown on plates 17, 18 represent a second lot received from Mr. Fisher after the first group, pictured on plates 12-16, had been typed and photographed. Material from both groups, plus a few specimens found by the writer on the site, figure in the 1953 report, to which the reader is referred for a complete analytical study.

PLATE 18

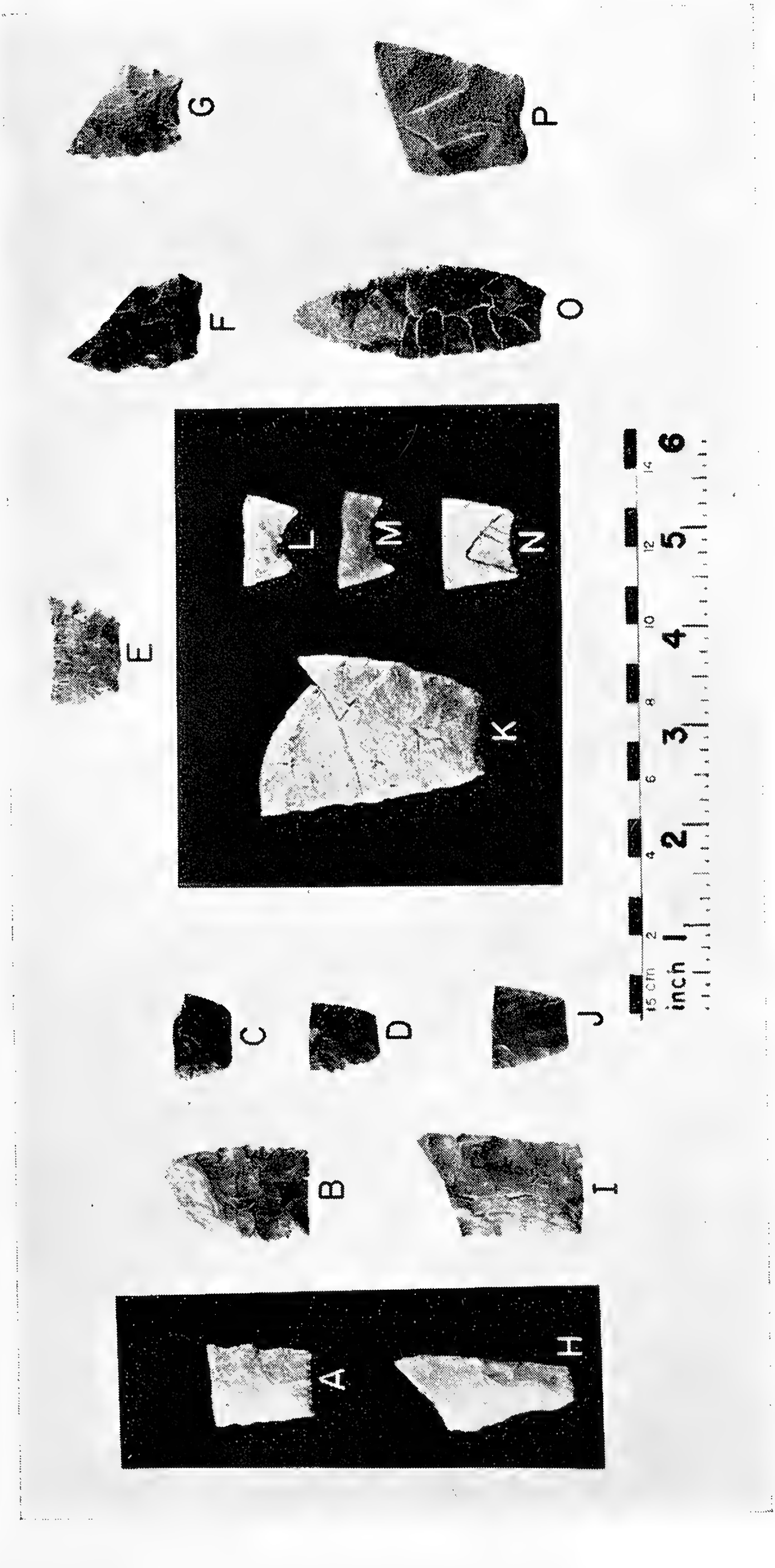

TABLE 1

TABI

Location, Source and Description

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
	Jefferson	Cape Vincent	Cedar Point	Rocky point, 20–40 feet above St. Lawrence River	—	Fred Cuppernall
16	"	—	—	—	—	N. Y. State Museu #21816
18	"	—	—	—	—	"
28	St. Lawrence	De Peyster	Near Mud Lake (probably north end, between Fish and Beaver Creeks)	—	—	C. B. Olds
12	Lewis	Croghan	CTE 1–2, c. ½ mi. east of mouth of Deer River, east side Black River	Surface find on duff on level spur above intermittent stream bed	None. Core of like material within 500 feet. Scatter of Archaic points in general vicinity	N. Y. State Museu #41459–1
	Essex	Ticonderoga	John Rafferty farm, west side Lake George, near foot	—	Following point found on same farm	Fort Ticonderoga Museum
	"	"	"	—	See last entry	"
	"	"	Fort Ticonderoga grounds	High rocky elevation above Lake Champlain	—	"
	Oswego	Schroeppel	Near Phoenix	—	—	George F. Chesbro
	Onondaga	Cicero	Channing Robinson farm (Syr. 5), Brewerton, south side Oneida River	High level field above river at foot of Oneida Lake	Surface find on extensive Laurentian site	Dr. William Hi dale, Syracuse, N.

uted Points from New York State

DESCRIPTION

Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
llow jasper	c. 3½″ long	—	—	—	—	Seen only in frame. Fred Cuppernall, Clayton, N. Y.
ottled light and dium gray flint pper Mercer?)	31/32″ 1⅜″ 5/16″ 77 mm. 35 mm. 8 mm.	Parallel sided	Both faces, c. ⅔	Lower edges and base	Good	Plates 2 A, B, figures G, g
ack flint (prob- ly Leray)	2 9/16″ ⅞″ 9/32″ 64.5 mm. 22 mm. 7 mm.	"	One face c. ⅓, other thinned near base	"	Fair	Plates 3 A, B, figures B, b
iny black flint robably Leray)	2 3/16″ 1⅛″ 3/16″ 55 mm. 28 mm. 5 mm.	Lower edges slightly incurvate	Full on both faces	"	Fine	Plates 4 A, B, figures F, f. C. B. Olds, Waddington, N. Y.
ttle Falls flint	1 9/16″ 13/16″ 3/16″ 40 mm. 21 mm. 5 mm.	Parallel sided	Both faces, c. ½ and ⅔	"	Good	Plates 2 A, B, figures C, c. Found by State Museum field party (1955)
ark gray flint	c. 2⅛″ long	Lower edges incurvate, base expanded	Full on both faces	—	Good	
reenish flint robably Deep- ll)	c. 1⅞″ long	Parallel sided	Both faces, c. ⅔	—	Fair	
ght gray flint	c. 2⅝″ long	Lower edges incurvate, base expanded	Both faces, c. ½	—	Good	
"	Basal section only, 1¾″ long, 1″ wide	Parallel sided	Both faces	—	"	George F. Chesbro, Phoenix, N. Y.
ed jasper	3¼″ long, 1″ wide	Lower edges slightly incurvate	Full on both faces	—	"	Drawing in W. M. Beauchamp, "Antiquities of Onondaga," Vol. X, figure 464, ms. N. Y. State Museum

TABLE 1

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION					SOURCE	DESCRIPTION								
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number	Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
	Jefferson	Cape Vincent	Cedar Point	Rocky point, 20–40 feet above St. Lawrence River	—	Fred Cuppernall	Yellow jasper	c. 3½″ long			—	—	—	—	Seen only in frame. Fred Cuppernall, Clayton, N. Y.
16	"	—	—	—	—	N. Y. State Museum #21816	Mottled light and medium gray flint (Upper Mercer?)	3 1/32″ 77 mm.	1⅜″ 35 mm.	5/16″ 8 mm.	Parallel sided	Both faces, c. ⅔	Lower edges and base	Good	Plates 2 A, B, figures G, g
18	"	—	—	—	—	"	Black flint (probably Leray)	2 9/16″ 64.5 mm.	⅞″ 22 mm.	9/32″ 7 mm.	"	One face c. ⅓, other thinned near base	"	Fair	Plates 3 A, B, figures B, b
28	St. Lawrence	De Peyster	Near Mud Lake (probably north end, between Fish and Beaver Creeks)	—	—	C. B. Olds	Shiny black flint (probably Leray)	2 3/16″ 55 mm.	1⅛″ 28 mm.	3/16″ 5 mm.	Lower edges slightly incurvate	Full on both faces	"	Fine	Plates 4 A, B, figures F, f. C. B. Olds, Waddington, N. Y.
12	Lewis	Croghan	CTE 1–2, c. ½ mi. east of mouth of Deer River, east side Black River	Surface find on duff on level spur above intermittent stream bed	None. Core of like material within 500 feet. Scatter of Archaic points in general vicinity	N. Y. State Museum #41459-1	Little Falls flint	1 9/16″ 40 mm.	13/16″ 21 mm.	3/16″ 5 mm.	Parallel sided	Both faces, c. ½ and ⅔	"	Good	Plates 2 A, B, figures C, c. Found by State Museum field party (1955)
	Essex	Ticonderoga	John Rafferty farm, west side Lake George, near foot	—	Following point found on same farm	Fort Ticonderoga Museum	Dark gray flint	c. 2⅛″ long			Lower edges incurvate, base expanded	Full on both faces	—	Good	
	"	"	"	—	See last entry	"	Greenish flint (probably Deepkill)	c. 1⅞″ long			Parallel sided	Both faces, c. ⅔	—	Fair	
	"	"	Fort Ticonderoga grounds	High rocky elevation above Lake Champlain	—	"	Light gray flint	c. 2⅝″ long			Lower edges incurvate, base expanded	Both faces, c. ½	—	Good	
	Oswego	Schroeppel	Near Phoenix	—	—	George F. Chesbro	"	Basal section only, 1¾″ long, 1″ wide			Parallel sided	Both faces	—	"	George F. Chesbro, Phoenix, N. Y.
	Onondaga	Cicero	Channing Robinson farm (Syr. 5), Brewerton, south side Oneida River	High level field above river at foot of Oneida Lake	Surface find on extensive Laurentian site	Dr. William Hinsdale, Syracuse, N. Y.	Red jasper	3¼″ long, 1″ wide			Lower edges slightly incurvate	Full on both faces	—	"	Drawing in W. M. Beauchamp, "Antiquities of Onondaga," Vol. X, figure 464, ms. N. Y. State Museum

TABL

Location, Source and Description (

PLATE CAPTION NUMBERS	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
1	Onondaga	—	—	—	—	N. Y. State Museu #27593
2	"	—	—	—	—	N. Y. State Museu #31593
3	"	—	—	—	—	" " "
4	"	—	—	—	—	" " "
15	"	Van Buren	—	—	—	N. Y. State Muse #31053
9	"	—	Cross Lake	—	—	N. Y. State Muse #31045
13	"	Lysander	—	—	—	N. Y. State Muse #31951
17	"	Van Buren	—	—	—	N. Y. State Muse #31449
20	"	" Lot 12	—	—	—	N. Y. State Muse #36285
5	"	Lysander	—	—	—	N. Y. State Muse #31047
32	"	—	Near Baldwinsville	—	—	Rochester Museum Arts and Scien AR 36293
36	"	—	—	—	—	N .Y. State Muse #31593

(*continued*)

luted Points from New York State

DESCRIPTION

Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
Banded gray and rown flint (Onondaga)	2¼″(est.) ⅞″ 7/32″ 57 mm. 22 mm. 5 mm.	Lower edges slightly incurvate	Full on both faces	Lower edges and base	Good	Tip broken recently. Plates 1 A, B, figures A, a
Red jasper	1 19/32″ 15/16″ ¼″ 40 mm. 23.5 mm. 6 mm.	Parallel sided	Both faces, c. ½ and ⅓	None	Fair	Plates 1 A, B, figures B, b
Gray flint (Onondaga)	1 17/32″ 1 3/32″ 7/32″ 39 mm. 27.5 mm. 5 mm.	Pentagonal	Full on both faces	Lower edges only	"	Plates 1 A, B, figures C, c
"	1 1/16″ ¾″ 3/16″ 27 mm. 18.5 mm. 5 mm.	"	"	Lower edges and base	"	Plates 1 A, B, figures D, d
Little Falls flint	2⅜″ 31/32″ ¼″ 60 mm. 24 mm. 6 mm.	Lower edges slightly incurvate	"	"	Good	Plates 2 A, B, figures F, f
Mottled gray and white flint (Upper Mercer?)	2 7/16″ 1⅛″ ¼″ 61.5 mm. 28 mm. 6 mm.	Parallel sided	Both faces, c. ⅔	Lower edges and base (slight)	Fair	Plates 1 A, B, figures I, i. Illustrated by Beauchamp, 1897, figure 14
Banded and mottled gray and white flint	2 1/32″ ⅞″ 9/32″ 52 mm. 22 mm. 7 mm.	"	Both faces, c. ½ and ⅔	Lower edges and base	"	Plates 2 A, B, figures D, d. Illustrated by Beauchamp, 1897, figure 13
Black flint (probably Leray)	2 7/32″ ⅞″ 5/16″ 56 mm. 22 mm. 8 mm.	"	Both faces, c. ⅓	"	"	Plates 3 A, B, figures A, a
Dark gray flint (Onondaga)	4⅛″ 1 3/16″ 9/32″ 104 mm. 30 mm. 7 mm.	"	Full on both faces	Lower edges and base (slight)	Excellent	Plates 3 A, B, figures D, d
Gray flint (Onondaga)	2 5/16″ 1″ 9/32″ 58 mm. 25.4 mm. 7 mm.	"	Both faces, c. ⅓	Lower edges and base	Fair	Plates 1 A, B, figures E, e
Dark greenish gray flint (Deepkill?)	1 13/16″ 15/16″ 3/16″ 46 mm. 24 mm. 5 mm.	Lower edges slightly incurvate	Nearly full on both faces	"	Good	One face heavily patinated, Plates 5 A, B, figures D, d
Mottled gray flint (Onondaga)	1 3/16″ 13/16″ 3/16″ 30 mm. 21 mm. 5 mm.	Pentagonal	Full on both faces	Slight on lower edges and base	Fair	Plate 6, figure C

Table 1 *(continued)*

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION: County	LOCATION: Township and Lot	LOCATION: Locus	LOCATION: Terrain	LOCATION: Association	SOURCE: Collection and Catalog Number	DESCRIPTION: Material	DESCRIPTION: Size L. B. T. (in. and mm.)	DESCRIPTION: Form	DESCRIPTION: Fluting	DESCRIPTION: Grinding	DESCRIPTION: Workmanship	DESCRIPTION: Addenda and Acknowledgments
1	Onondaga	—	—	—	—	N. Y. State Museum #27593	Banded gray and brown flint (Onondaga)	2¼″(est.) ⅞″ 7/32″ 57 mm. 22 mm. 5 mm.	Lower edges slightly incurvate	Full on both faces	Lower edges and base	Good	Tip broken recently. Plates 1 A, B, figures A, a
2	"	—	—	—	—	N. Y. State Museum #31593	Red jasper	1 19/32″ 15/16″ ¼″ 40 mm. 23.5 mm. 6 mm.	Parallel sided	Both faces, c. ½ and ⅓	None	Fair	Plates 1 A, B, figures B, b
3	"	—	—	—	—	" "	Gray flint (Onondaga)	1 17/32″ 1 3/32″ 7/32″ 39 mm. 27.5 mm. 5 mm.	Pentagonal	Full on both faces	Lower edges only	"	Plates 1 A, B, figures C, c
4	"	—	—	—	—	" "	"	1 1/16″ ¾″ 3/16″ 27 mm. 18.5 mm. 5 mm.	"	"	Lower edges and base	"	Plates 1 A, B, figures D, d
15	"	Van Buren	—	—	—	N. Y. State Museum #31053	Little Falls flint	2⅜″ 31/32″ ¼″ 60 mm. 24 mm. 6 mm.	Lower edges slightly incurvate	"	"	Good	Plates 2 A, B, figures F, f
9	"	—	Cross Lake	—	—	N. Y. State Museum #31045	Mottled gray and white flint (Upper Mercer?)	2 7/16″ 1⅛″ ¼″ 61.5 mm. 28 mm. 6 mm.	Parallel sided	Both faces, c. ⅔	Lower edges and base (slight)	Fair	Plates 1 A, B, figures I, i. Illustrated by Beauchamp, 1897, figure 14
13	"	Lysander	—	—	—	N. Y. State Museum #31951	Banded and mottled gray and white flint	2 1/32″ ⅞″ 9/32″ 52 mm. 22 mm. 7 mm.	"	Both faces, c. ½ and ⅔	Lower edges and base	"	Plates 2 A, B, figures D, d. Illustrated by Beauchamp, 1897, figure 13
17	"	Van Buren	—	—	—	N. Y. State Museum #31449	Black flint (probably Leray)	2 7/32″ ⅞″ 5/16″ 56 mm. 22 mm. 8 mm.	"	Both faces, c. ⅓	"	"	Plates 3 A, B, figures A, a
20	"	" Lot 12	—	—	—	N. Y. State Museum #36285	Dark gray flint (Onondaga)	4⅛″ 1 3/16″ 9/32″ 104 mm. 30 mm. 7 mm.	"	Full on both faces	Lower edges and base (slight)	Excellent	Plates 3 A, B, figures D, d
5	"	Lysander	—	—	—	N. Y. State Museum #31047	Gray flint (Onondaga)	2 5/16″ 1″ 9/32″ 58 mm. 25.4 mm. 7 mm.	"	Both faces, c. ⅓	Lower edges and base	Fair	Plates 1 A, B, figures E, e
32	"	—	Near Baldwinsville	—	—	Rochester Museum of Arts and Sciences AR 36293	Dark greenish gray flint (Deepkill?)	1 13/16″ 15/16″ 3/16″ 46 mm. 24 mm. 5 mm.	Lower edges slightly incurvate	Nearly full on both faces	"	Good	One face heavily patinated, Plates 5 A, B, figures D, d
36	"	—	—	—	—	N .Y. State Museum #31593	Mottled gray flint (Onondaga)	1 3/16″ 13/16″ 3/16″ 30 mm. 21 mm. 5 mm.	Pentagonal	Full on both faces	Slight on lower edges and base	Fair	Plate 6, figure C

TABL

Location, Source and Description o

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
37	Onondaga	—	—	—	—	N. Y. State Museur #31593
34	"	—	—	—	—	"
	Cayuga	Conquest	Haiti Island, near Mosquito Point, opposite mouth of Owasco outlet, on Seneca River	Elevated island in marsh	Following points found on same site	William Warder
	"	"	"	"	See last entry	William Warder
	"	"	"	"	"	Earl Mann
39	"	Montezuma	Jacob Snyder gladiola farm site, 1 mi. northwest of Montezuma	Low marshy flat	Much early Pt. Peninsula and Hopewellian material from this site	Arthur J. Seelye
	Wayne	Wolcott	Old Ed Reiley farm (now Teller and Coxmer farms) c. ½ mi. east of North Wolcott	Low ground near marsh	—	Edward T. Brown co lection, Wolcott, N. Y
38	"	Butler	Excavated on Arthur J. Seelye farm, town line Rose and Butler, c. 2 mi. southwest of Wolcott	Dug from roadside bank on rise of c. 8 ft. above small stream. "Ashes and a little charcoal at subsoil level, but no bone." From sand subsoil.	—	Arthur J. Seelye
41	Wayne	Rose	Norman Young farm, c. 2½ mi. east of North Rose (now Doty farm)	On upper waters of Mudge Creek, west side, in high (10–20′ above creek level) cultivated field	Following point found on same field	"

(*continued*)

Fluted Points from New York State

DESCRIPTION

Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Work-manship	Addenda and Acknowledgments
Mottled gray flint (Onondaga)	1″ 7/8″ 3/16″ 25.4 mm. 22 mm. 5 mm.	Pentagonal	Nearly full on both faces	Lower edges and base	Fair	Plate 6, figure D. Point broken and crudely rechipped
Light gray chalcedony	1 5/8″ 1″ 7/32″ 41 mm. 25.4 mm. 6 mm.	Parallel sided	Both faces, c. 1/2	Very slight on base	"	Plate 6, figure A. An aberrant form.
Bluish black flint (Upper Mercer?)	1 3/4″ long	Lower edges slightly incurvate	Both faces, c. 2/3	—	"	William Warder, Geneva, N. Y.
Light grayish flint	Basal fragment 1 1/2″ long	Parallel sided	Both faces	—	"	"
Gray flint (Onondaga)	1 7/8″ long	Lower edges slightly incurvate	Both faces, c. 3/4	—	"	A strong resemblance to first specimen from same site, except for material. Haiti Island probably a camp site. Earl Mann, Jordan, N. Y.
Gray flint	1 11/16″ 7/8″ — 42.5 mm. 22 mm. —	Parallel sided	Full on both faces	—	Good	Plate 7, figure B. Arthur J. Seelye, Wolcott, N. Y.
Brown flint	2 9/16″ long	"	Both faces, c. 1/3	—	Poor	Data from Carl Jones and Arthur J. Seelye, Wolcott, N. Y.
"	1 11/16″ long	Lower edges slightly incurvate	Full on both faces	—	Good	Plate 7, figures A, a. Excavated point. Arthur J. Seelye, Wolcott, N. Y.
Blue-gray flint	2 1/8″ 1″ — 54 mm. 25.4 mm. —	Parallel sided	"	—	"	Plate 7, figures D, d. Arthur J. Seelye, Wolcott, N. Y.

Table 1 (*continued*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	Location: County	Location: Township and Lot	Location: Locus	Location: Terrain	Location: Association	Source: Collection and Catalog Number	Description: Material	Description: Size L. (in. and mm.)	Description: Size B.	Description: Size T.	Description: Form	Description: Fluting	Description: Grinding	Description: Workmanship	Description: Addenda and Acknowledgments
37	Onondaga	—	—	—	—	N. Y. State Museum #31593	Mottled gray flint (Onondaga)	1″ 25.4 mm.	⅞″ 22 mm.	3/16″ 5 mm.	Pentagonal	Nearly full on both faces	Lower edges and base	Fair	Plate 6, figure D. Point broken and crudely rechipped
34	"	—	—	—	—	"	Light gray chalcedony	1⅝″ 41 mm.	1″ 25.4 mm.	7/32″ 6 mm.	Parallel sided	Both faces, c. ½	Very slight on base	"	Plate 6, figure A. An aberrant form.
	Cayuga	Conquest	Haiti Island, near Mosquito Point, opposite mouth of Owasco outlet, on Seneca River	Elevated island in marsh	Following points found on same site	William Warder	Bluish black flint (Upper Mercer?)	1¾″ long			Lower edges slightly incurvate	Both faces, c. ⅔	—	"	William Warder, Geneva, N. Y.
	"	"	"	"	See last entry	William Warder	Light grayish flint	Basal fragment 1½″ long			Parallel sided	Both faces	—	"	"
	"	"	"	"	"	Earl Mann	Gray flint (Onondaga)	1⅞″ long			Lower edges slightly incurvate	Both faces, c. ¾	—	"	A strong resemblance to first specimen from same site, except for material. Haiti Island probably a camp site. Earl Mann, Jordan, N. Y.
39	"	Montezuma	Jacob Snyder gladiola farm site, 1 mi. northwest of Montezuma	Low marshy flat	Much early Pt. Peninsula and Hopewellian material from this site	Arthur J. Seelye	Gray flint	1 11/16″ 42.5 mm.	⅞″ 22 mm.	— —	Parallel sided	Full on both faces	—	Good	Plate 7, figure B. Arthur J. Seelye, Wolcott, N. Y.
	Wayne	Wolcott	Old Ed Reiley farm (now Teller and Coxmer farms) c. ½ mi. east of North Wolcott	Low ground near marsh	—	Edward T. Brown collection, Wolcott, N. Y.	Brown flint	2 9/16″ long			"	Both faces, c. ⅓	—	Poor	Data from Carl Jones and Arthur J. Seelye, Wolcott, N. Y.
38	"	Butler	Excavated on Arthur J. Seelye farm, town line Rose and Butler, c. 2 mi. southwest of Wolcott	Dug from roadside bank on rise of c. 8 ft. above small stream. "Ashes and a little charcoal at subsoil level, but no bone." From sand subsoil.	—	Arthur J. Seelye	"	1 11/16″ long			Lower edges slightly incurvate	Full on both faces	—	Good	Plate 7, figures A, a. Excavated point. Arthur J. Seelye, Wolcott, N. Y.
41	Wayne	Rose	Norman Young farm, c. 2½ mi. east of North Rose (now Doty farm)	On upper waters of Mudge Creek, west side, in high (10–20′ above creek level) cultivated field	Following point found on same field	"	Blue-gray flint	2⅛″ 54 mm.	1″ 25.4 mm.	— —	Parallel sided	"	—	"	Plate 7, figures D, d. Arthur J. Seelye, Wolcott, N. Y.

TABL[E]

Location, Source and Description o[f]

PLATE CAPTION NUMBERS	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
40	Wayne	Rose	Norman Young farm, c. 2½ mi. east of North Rose (now Doty farm)	On upper waters of Mudge Creek, west side, in high (10–20′ above creek level) cultivated field	See last entry	Arthur J. Seelye
30	"	Macedon	Hance farm, near village of Macedon	—	—	Rochester Museum o[f] Arts and Science[s] #39281
31	Monroe	—	Genesee Valley, near Rochester(?)	—	—	Rochester Museum o[f] Arts and Science[s] #37781
29	"	Brighton	Rowland farm, along Allen's Creek, near Pittsford	—	—	Rochester Museum o[f] Arts and Science[s] #43626
35	"	Greece	Bonesteel farm	—	—	N. Y. State Museum #35958
	Ontario	Farmington Lot 86	Kyte farm, west side town	—	—	—
	"	Victor	—	—	—	Buffalo Historical Society (55/1074)
14	Livingston	—	Probably vicinity of Sonyea, Genesee Valley	—	—	N. Y. State Museum #15910
33	Yates	—	Frank Schultz farm, near head of Canandaigua Lake, east side	—	—	Rochester Museum o[f] Arts and Science[s] #36305
43	Tompkins	Ithaca	Cornell University campus	On high ground overlooking foot of Cayuga Lake	Following point from same area	DeWitt Historical Society of Tompkins Co. (Ithaca)

(continued)

Fluted Points from New York State

	DESCRIPTION							
Material	Size L. (in. and mm.)	Size B.	Size T.	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
Gray-black flint	2¼″ 57 mm.	15/16″ 24 mm.	— —	Parallel sided	Both faces, ⅔	—	Good	Plate 7, figures C, c. Arthur J. Seelye, Wolcott, N. Y.
Mottled gray flint (western Onondaga)	—	—	—	"	Slight on both faces	Slight on lower sides and base	Poor	Fire damaged basal fragment. Plates 5 A, B, figures B, b
Mottled gray and black flint (Deepkill)	2″ 50 mm.	1 1/16″ 27 mm.	¼″ 6 mm.	"	Both faces, c. ⅔	Lower sides and base	Good	Plates 5 A, B, figures C, c
Mottled gray and black flint (western Onondaga)	1 7/16″ 37 mm.	⅞″ 22 mm.	5/32″ 4 mm.	"	Both faces, c. ½ and ⅓	"	Fair	Plates 5 A, B, figures A, a
Mottled gray and tan flint (western Onondaga)	2 13/32″ 61 mm.	1 3/16″ 30 mm.	5/32″ 4 mm.	Lower edges slightly incurvate	Both sides, base thinned only	Lower edges and base	Excellent	Plate 6, figure B. One of thinnest specimens seen. Aberrant form
Black flint	2 3/16″	1″	—	Parallel sided	Both faces, c. ⅓	—	Good	Data from Lewis F. Allen, Macedon, N. Y.
Mottled gray and tan flint (western Onondaga)	— —	15/16″ 24 mm.	⅛″ 3 mm.	"	One face c. ¼. Other face thinned by 3 short flakes	"	Fair	Basal fragment. Data from Richard L. McCarthy, Lockport, N. Y.
Yellow jasper	2¼″ 57 mm.	1 1/16″ 27 mm.	5/16″ 8 mm.	"	Both faces, nearly full	"	Good	Plates 2 A, B, figures E, e
Blue-black flint (Upper Mercer?)	2 11/16″ 68 mm.	1¼″ 32 mm.	¼″ 6 mm.	"	Both faces, c. ½ and ⅔	"	Fair	Plates 5 A, B, figures E, e
Dark gray flint	2¼″ 57 mm.	1″ 25.4 mm.	— —	"	Both faces, c. ⅔	—	"	Plate 8, figures A, a. Photographs from Frank H. H. Roberts, Jr., Smithsonian Inst. Data from W. Glenn Norris, Ithaca, N. Y.

Table 1 (continued)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION: County	LOCATION: Township and Lot	LOCATION: Locus	LOCATION: Terrain	LOCATION: Association	SOURCE: Collection and Catalog Number	DESCRIPTION: Material	Size (in. and mm.): L.	Size: B.	Size: T.	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
40	Wayne	Rose	Norman Young farm, c. 2½ mi. east of North Rose (now Doty farm)	On upper waters of Mudge Creek, west side, in high (10–20′ above creek level) cultivated field	See last entry	Arthur J. Seelye	Gray-black flint	2¼″ 57 mm.	15/16″ 24 mm.	— —	Parallel sided	Both faces, ⅔	—	Good	Plate 7, figures C, c. Arthur J. Seelye, Wolcott, N. Y.
30	"	Macedon	Hance farm, near village of Macedon	—	—	Rochester Museum of Arts and Sciences #39281	Mottled gray flint (western Onondaga)	—	—	—	"	Slight on both faces	Slight on lower sides and base	Poor	Fire damaged basal fragment. Plates 5 A, B, figures B, b
31	Monroe	—	Genesee Valley, near Rochester(?)	—	—	Rochester Museum of Arts and Sciences #37781	Mottled gray and black flint (Deepkill)	2″ 50 mm.	1 1/16″ 27 mm.	¼″ 6 mm.	"	Both faces, c. ⅔	Lower sides and base	Good	Plates 5 A, B, figures C, c
29	"	Brighton	Rowland farm, along Allen's Creek, near Pittsford	—	—	Rochester Museum of Arts and Sciences #43626	Mottled gray and black flint (western Onondaga)	1 7/16″ 37 mm.	⅞″ 22 mm.	5/32″ 4 mm.	"	Both faces, c. ½ and ⅓	"	Fair	Plates 5 A, B, figures A, a
35	"	Greece	Bonesteel farm	—	—	N. Y. State Museum #35958	Mottled gray and tan flint (western Onondaga)	2 13/32″ 61 mm.	1 3/16″ 30 mm.	5/32″ 4 mm.	Lower edges slightly incurvate	Both sides, base thinned only	Lower edges and base	Excellent	Plate 6, figure B. One of thinnest specimens seen. Aberrant form
	Ontario	Farmington Lot 86	Kyte farm, west side town	—	—	—	Black flint	2 3/16″	1″	—	Parallel sided	Both faces, c. ⅓	—	Good	Data from Lewis F. Allen, Macedon, N. Y.
	"	Victor	—	—	—	Buffalo Historical Society (55/1074)	Mottled gray and tan flint (western Onondaga)	— —	15/16″ 24 mm.	⅛″ 3 mm.	"	One face c. ¼. Other face thinned by 3 short flakes	"	Fair	Basal fragment. Data from Richard L. McCarthy, Lockport, N. Y.
14	Livingston	—	Probably vicinity of Sonyea, Genesee Valley	—	—	N. Y. State Museum #15910	Yellow jasper	2¼″ 57 mm.	1 1/16″ 27 mm.	5/16″ 8 mm.	"	Both faces, nearly full	"	Good	Plates 2 A, B, figures E, e
33	Yates	—	Frank Schultz farm, near head of Canandaigua Lake, east side	—	—	Rochester Museum of Arts and Sciences #36305	Blue-black flint (Upper Mercer?)	2 11/16″ 68 mm.	1¼″ 32 mm.	¼″ 6 mm.	"	Both faces, c. ½ and ⅔	"	Fair	Plates 5 A, B, figures E, e
43	Tompkins	Ithaca	Cornell University campus	On high ground overlooking foot of Cayuga Lake	Following point from same area	DeWitt Historical Society of Tompkins Co. (Ithaca)	Dark gray flint	2¼″ 57 mm.	1″ 25.4 mm.	— —	"	Both faces, c. ⅔	—	"	Plate 8, figures A, a. Photographs from Frank H. H. Roberts, Jr., Smithsonian Inst. Data from W. Glenn Norris, Ithaca, N. Y.

TABLE

Location, Source and Description of

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
44	Tompkins	Ithaca	Cornell University campus	On high ground overlooking foot of Cayuga Lake	See last entry	DeWitt Historical Society of Tompkins Co. (Ithaca)
42	Chemung	Horseheads	Near Horseheads	—	—	"
45	Tioga	Nichols	Near Nichols	—	—	Foster Disinger
46	"	"	"	—	—	"
47	Broome	Kirkwood	Grounds of Binghamton State Hospital	On high terrace overlooking Susquehanna River	Site has yielded numerous Lamoka type points	"
	"	Union	Between Willow Point and Vestal	—	—	"
	"	Windsor	At or near Windsor on Susquehanna	—	—	Marius Mallery, Windsor
	Chenango	—	Near Bainbridge	—	—	Mortimer C. Howe coll., Colgate University, Hamilton, N. Y.

(*continued*)

luted Points from New York State

DESCRIPTION

Material	Size L.	Size B.	Size T.	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
	(in. and mm.)							
Dark gray flint	2⅛″ 54 mm.	⅞″ 22 mm.	— —	Parallel sided	Full on both faces	—	Good	Plate 8, figures B, b. Photographs from Frank H. H. Roberts, Jr., Smithsonian Inst. Data from W. Glenn Norris, Ithaca, N. Y.
Yellow jasper	3$\frac{1}{16}$″	1$\frac{3}{16}$″	—	Lower edges incurvate	Both faces, c. ⅓, ½	Lower edges and base	"	Plate 7, figures E, e. Data and illustration from W. Glenn Norris, Ithaca, N. Y.
Mottled gray flint (Onondaga)	2⅝″ 66.5 mm.	1$\frac{3}{32}$″ 28 mm.	— —	Parallel sided	Both faces, c. ⅓ and ⅔	Slight on base	Fair	Plate 9, figure A. Data and illustration from Foster Disinger, Binghamton, N. Y.
Mottled dark blue flint (Upper Mercer?)	3⅜″	1¼″	—	Lanceolate	Both faces, c. ½ and ⅕	Lower edges	Poor	Plate 9, figure B. Data and illustration from Foster Disinger, Binghamton, N. Y. An aberrant form.
Mottled gray flint (Onondaga)	1½″ 38 mm.	$\frac{27}{32}$″ 21 mm.	— —	Parallel sided	Nearly full on both faces	Lower edges and base	Good	Plate 9, figures C, c. Data and illustration from Foster Disinger, Binghamton, N. Y.
"	— —	1$\frac{7}{16}$″ 36 mm.	— —	"	Full on both faces	"	"	Basal fragment. Data from Foster Disinger, Binghamton, N. Y.
Gray flint	3$\frac{1}{16}$″ 78 mm.	1$\frac{3}{16}$″ 30 mm.	— —	"	Both faces, c. ⅓	—	Fair	Data from Foster Disinger, Binghamton, N. Y.
Mottled brown and gray flint (Onondaga)	—	—	—	"	Both faces	Slight on base	"	Basal fragment only. Found by Herbert Bigford, Earlville, N. Y.

TABLE 1 (*continued*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION					SOURCE	DESCRIPTION								
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number	Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
44	Tompkins	Ithaca	Cornell University campus	On high ground overlooking foot of Cayuga Lake	See last entry	DeWitt Historical Society of Tompkins Co. (Ithaca)	Dark gray flint	2 1/8″ 54 mm.	7/8″ 22 mm.	— —	Parallel sided	Full on both faces	—	Good	Plate 8, figures B, b. Photographs from Frank H. H. Roberts, Jr., Smithsonian Inst. Data from W. Glenn Norris, Ithaca, N. Y.
42	Chemung	Horseheads	Near Horseheads	—	—	"	Yellow jasper	3 1/16″	1 3/16″	—	Lower edges incurvate	Both faces, c. 1/3, 1/2	Lower edges and base	"	Plate 7, figures E, e. Data and illustration from W. Glenn Norris, Ithaca, N. Y.
45	Tioga	Nichols	Near Nichols	—	—	Foster Disinger	Mottled gray flint (Onondaga)	2 5/8″ 66.5 mm.	1 3/32″ 28 mm.	— —	Parallel sided	Both faces, c. 1/3 and 2/3	Slight on base	Fair	Plate 9, figure A. Data and illustration from Foster Disinger, Binghamton, N. Y.
46	"	"	"	—	—	"	Mottled dark blue flint (Upper Mercer?)	3 3/8″	1 1/4″	—	Lanceolate	Both faces, c. 1/2 and 1/5	Lower edges	Poor	Plate 9, figure B. Data and illustration from Foster Disinger, Binghamton, N. Y. An aberrant form.
47	Broome	Kirkwood	Grounds of Binghamton State Hospital	On high terrace overlooking Susquehanna River	Site has yielded numerous Lamoka type points	"	Mottled gray flint (Onondaga)	1 1/2″ 38 mm.	27/32″ 21 mm.	— —	Parallel sided	Nearly full on both faces	Lower edges and base	Good	Plate 9, figures C, c. Data and illustration from Foster Disinger, Binghamton, N. Y.
	"	Union	Between Willow Point and Vestal	—	—	"	"	— —	1 7/16″ 36 mm.	— —	"	Full on both faces	"	"	Basal fragment. Data from Foster Disinger, Binghamton, N. Y.
	"	Windsor	At or near Windsor on Susquehanna	—	—	Marius Mallery, Windsor	Gray flint	3 1/16″ 78 mm.	1 3/16″ 30 mm.	— —	"	Both faces, c. 1/3	—	Fair	Data from Foster Disinger, Binghamton, N. Y.
	Chenango	—	Near Bainbridge	—	—	Mortimer C. Howe coll., Colgate University, Hamilton, N. Y.	Mottled brown and gray flint (Onondaga)	—	—	—	"	Both faces	Slight on base	"	Basal fragment only. Found by Herbert Bigford, Earlville, N. Y.

TABL

Location, Source and Description o

Plate Caption Number	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
10	Madison	Fenner	Surface find on Nichols Pond site	Level field above small stream and pond	On prehistoric Iroquoian village	Robert Roberts
7	Otsego	Milford	Townsend Bishop farm, c. ½ mile east of Portlandville	In small valley along brook draining into Susquehanna River on west flank of Crumhorn Mountain	No artifacts nearby	Rowan Spraker
26	"	Richfield	About midway on west shore Canaderago Lake	On low rise in level field elevated c. 25 feet above lake	A second very similar point from same field	Leo N. McLean, Cat #M438
	"	"	"	"	Scatter of Laurentian artifacts in vicinity	"
27	"	Otsego	East bank Oaks Creek	Low ground near swale	Thin scatter of Laurentian and Point Peninsula material	Leo N. McLean, Cat. #M439
	Delaware	Roxbury	Tyler flat, east side road (R. 30), northern outskirts of Roxbury, near spring, north of pumping station	Flood plain along west bank, East Branch Delaware River	Following very similar point from same field	Ralph S. Ives
	"	"	"	"	Found very close to last entry. Many Laurentian objects on same site	Harry A. Reed, Jr.

(*continued*)

luted Points from New York State

DESCRIPTION

Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
ottled tan and rown jasper	1½″ 38 mm.	15/16″ 24 mm.	¼″ 6 mm.	Parallel sided	Both faces, nearly full	Slight on base and extreme lower edges	Fair	Plates 2 A, B, figures B, b. Heavily patinated. Tip looks broken and reworked. Robert Roberts, Canastota, N. Y.
rown jasper	3 5/16″ 84 mm.	1 9/32″ 32.5 mm.	⅜″ 9.5 mm.	"	Both faces, c. ½ and full	Very slight on lower sides and base	Fine	Plates 1 A, B, figures G, g. Rowan Spraker, Cooperstown, N. Y.
Dark gray flint (Onondaga)	2 1/16″ 52 mm.	1 1/16″ 27 mm.	¼″ 6 mm.	Lower edges slightly incurvate	Full on both faces	Very slight on base and lower edges	Fair	Plates 4 A, B, figures D, d. Tip reworked. Data from Leo N. McLean, Richfield Springs, N. Y. An aberrant form.
"	—	—	—	—	"	—	"	"
Mottled gray and tan flint (western N. Y. Onondaga)	—	—	—	Parallel sided	—	Lower edges and base	"	Plates 4 A, B, figures E, e. Basal portion only. Data from Leo N. McLean, Richfield Springs, N. Y.
Tan flint	1½″ 38 mm.	1″ 25.4 mm.	— —	"	Both faces, c. ½	Base only	Fair	Ralph S. Ives, Roxbury, N. Y.
"	1 1/16″ 27 mm.	13/16″ 20 mm.	— —	Triangular	Both faces, nearly full	"	"	Data from Ralph S. Ives and Harry A, Reed, Jr., Sidney, N. Y.

TABLE 1 *(continued)*

Location, Source and Description of Fluted Points from New York State

Plate Caption Number	LOCATION					SOURCE	DESCRIPTION								
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number	Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
10	Madison	Fenner	Surface find on Nichols Pond site	Level field above small stream and pond	On prehistoric Iroquoian village	Robert Roberts	Mottled tan and brown jasper	1½″ 38 mm.	15/16″ 24 mm.	¼″ 6 mm.	Parallel sided	Both faces, nearly full	Slight on base and extreme lower edges	Fair	Plates 2 A, B, figures B, b. Heavily patinated. Tip looks broken and reworked. Robert Roberts, Canastota, N. Y.
7	Otsego	Milford	Townsend Bishop farm, c. ½ mile east of Portlandville	In small valley along brook draining into Susquehanna River on west flank of Crumhorn Mountain	No artifacts nearby	Rowan Spraker	Brown jasper	3 5/16″ 84 mm.	1 9/32″ 32.5 mm.	⅜″ 9.5 mm.	"	Both faces, c. ½ and full	Very slight on lower sides and base	Fine	Plates 1 A, B, figures G, g. Rowan Spraker, Cooperstown, N. Y.
26	"	Richfield	About midway on west shore Canaderago Lake	On low rise in level field elevated c. 25 feet above lake	A second very similar point from same field	Leo N. McLean, Cat. #M438	Dark gray flint (Onondaga)	2 1/16″ 52 mm.	1 1/16″ 27 mm.	¼″ 6 mm.	Lower edges slightly incurvate	Full on both faces	Very slight on base and lower edges	Fair	Plates 4 A, B, figures D, d. Tip reworked. Data from Leo N. McLean, Richfield Springs, N. Y. An aberrant form.
	"	"	"	"	Scatter of Laurentian artifacts in vicinity	"	"	—	—	—	—	"	—	"	"
27	"	Otsego	East bank Oaks Creek	Low ground near swale	Thin scatter of Laurentian and Point Peninsula material	Leo N. McLean, Cat. #M439	Mottled gray and tan flint (western N. Y. Onondaga)	—	—	—	Parallel sided	—	Lower edges and base	"	Plates 4 A, B, figures E, e. Basal portion only. Data from Leo N. McLean, Richfield Springs, N. Y.
	Delaware	Roxbury	Tyler flat, east side road (R. 30), northern outskirts of Roxbury, near spring, north of pumping station	Flood plain along west bank, East Branch Delaware River	Following very similar point from same field	Ralph S. Ives	Tan flint	1½″ 38 mm.	1″ 25.4 mm.	— —	"	Both faces, c. ½	Base only	Fair	Ralph S. Ives, Roxbury, N. Y.
	"	"	"	"	Found very close to last entry. Many Laurentian objects on same site	Harry A. Reed, Jr.	"	1 1/16″ 27 mm.	13/16″ 20 mm.	— —	Triangular	Both faces, nearly full	"	"	Data from Ralph S. Ives and Harry A. Reed, Jr., Sidney, N. Y.

TABI

Location, Source and Description

PLATE CAPTION NUMBERS	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
23	Ulster	Shawangunk	Probably on historic Esopus town of New Fort, near Wallkill	On sandy plateau about 75 feet above Shawangunk Kill, a tributary of Wallkill	—	Miss Joyce McHug Wallkill, N. Y.
22	"	Esopus	Probably on Kingston Point	On high sand bluff overlooking Hudson and mouth of Rondout Creek. Dug from c. 4 feet below surface (2 feet dark refuse, 2 feet clear sand)	Overlying 2 feet dark refuse contained Laurentian and other artifacts	N. Y. State Museu #41519–1
25	Orange	Montgomery	Twin Fields site, 1½ miles northwest of Allard's Corners	High level fields along Dwaarkill	Sites of several cultures located on these fields	Bear Mountain Trai side Museum, #AA 43/12–0
24	"	"	"	"	"	Bear Mountain Trai side Museum, #AA 42/12–0
	"	"	"	"	"	Coll. Mr. Clark nea Allard's Corners
	"	"	Found less than a mile east of Allard's Corners	—	—	"
6	Greene	Coxsackie	Vicinity of Coxsackie	Probably high level fields along Hudson River	Two following points probably from same locality	N. Y. State Museun #36405–1
8	"	"	"	"	See last entry	N. Y. State Museun #36405–2

(*continued*)

uted Points from New York State

DESCRIPTION

Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
:own jasper	2 7/32″ 1″ 1/4″ 56 mm. 25.4 mm. 6 mm.	Lower edges slightly incurvate	Full on both faces	Lower edge and base	Good	Plates 4, A, B, figures A, a. Tip seems broken and reworked. Data from Stewart H. Stephens, Wallkill, N. Y.
ark brown jasper	2 13/32″ 1″ 5/16″ 61 mm. 25.4 mm. 8 mm.	Lower edges incurvate	Both faces, c. 1/2 and 1/3	Lower edges and base	"	Plates 3 A, B, figures F, f. Found in presence of James Shafer, Poughkeepsie, N. Y., and presented by him to N. Y. State Museum. Very similar to last entry.
Iottled green, lack and maroon int (Deepkill)	— 15/16″ 1/4″ — 24 mm. 6 mm.	Parallel sided	Both faces, c. 1/3	"	Fair	Plates 4 A, B, figures C, c. Tip broken evidently in use. Data from John C. Orth, Bear Mountain Museum.
ight gray flint Fort Ann)	— 1″ 1/4″ — 25.4 mm. 6 mm.	"	"	None	Poor	Plates 4 A, B, figures B, b. Tip missing. Data from John C. Orth.
Brown jasper	c. 2 1/2″ long	—	—	—	—	Data from Bear Mountain Museum through Mr. Orth
Olive-green flint Deepkill?)	c. 1 1/2″ long	—	—	—	—	"
Mottled light and lark brown jasper	3 11/32″ 1 1/8″ 11/32″ 85 mm. 29 mm. 9 mm.	Parallel sided	Both faces, c. 1/2 and 2/3	Lower edges and base	Fine	Plates 1 A, B, figures F, f. Similar to example from Crumhorn Mountain. (See plate 1 A, B, figures G, g)
Mottled gray and greenish flint (Deepkill)	3 7/32″ 1 3/16″ 9/32″ 82 mm. 30 mm. 7 mm.	Lower edges slightly incurvate	Both faces, c. 1/3	Lower edges and base (slightly)	"	Plates 1 A, B, figures H, h

TABLE 1 (*continued*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION: County	LOCATION: Township and Lot	LOCATION: Locus	LOCATION: Terrain	LOCATION: Association	SOURCE: Collection and Catalog Number	DESCRIPTION: Material	DESCRIPTION: Size L. (in. and mm.)	DESCRIPTION: Size B. (in. and mm.)	DESCRIPTION: Size T. (in. and mm.)	DESCRIPTION: Form	DESCRIPTION: Fluting	DESCRIPTION: Grinding	DESCRIPTION: Workmanship	DESCRIPTION: Addenda and Acknowledgments
23	Ulster	Shawangunk	Probably on historic Esopus town of New Fort, near Wallkill	On sandy plateau about 75 feet above Shawangunk Kill, a tributary of Wallkill	—	Miss Joyce McHugh, Wallkill, N. Y.	Brown jasper	2 7/32″ 56 mm.	1″ 25.4 mm.	1/4″ 6 mm.	Lower edges slightly incurvate	Full on both faces	Lower edge and base	Good	Plates 4, A, B, figures A, a. Tip seems broken and reworked. Data from Stewart H. Stephens, Wallkill, N. Y.
22	"	Esopus	Probably on Kingston Point	On high sand bluff overlooking Hudson and mouth of Rondout Creek. Dug from c. 4 feet below surface (2 feet dark refuse, 2 feet clear sand)	Overlying 2 feet dark refuse contained Laurentian and other artifacts	N. Y. State Museum #41519-1	Dark brown jasper	2 13/32″ 61 mm.	1″ 25.4 mm.	5/16″ 8 mm.	Lower edges incurvate	Both faces, c. 1/2 and 1/3	Lower edges and base	"	Plates 3 A, B, figures F, f. Found in presence of James Shafer, Poughkeepsie, N. Y., and presented by him to N. Y. State Museum. Very similar to last entry.
25	Orange	Montgomery	Twin Fields site, 1 1/2 miles northwest of Allard's Corners	High level fields along Dwaarkill	Sites of several cultures located on these fields	Bear Mountain Trailside Museum, #AA-43/12-0	Mottled green, black and maroon flint (Deepkill)	— —	15/16″ 24 mm.	1/4″ 6 mm.	Parallel sided	Both faces, c. 1/3	"	Fair	Plates 4 A, B, figures C, c. Tip broken evidently in use. Data from John C. Orth, Bear Mountain Museum.
24	"	"	"	"	"	Bear Mountain Trailside Museum, #AA-42/12-0	Light gray flint (Fort Ann)	— —	1″ 25.4 mm.	1/4″ 6 mm.	"	"	None	Poor	Plates 4 A, B, figures B, b. Tip missing. Data from John C. Orth.
	"	"	"	"	"	Coll. Mr. Clark near Allard's Corners	Brown jasper	c. 2 1/2″ long			—	—	—	—	Data from Bear Mountain Museum through Mr. Orth
	"	"	Found less than a mile east of Allard's Corners	—	—	"	Olive-green flint (Deepkill?)	c. 1 1/2″ long			—	—	—	—	"
6	Greene	Coxsackie	Vicinity of Coxsackie	Probably high level fields along Hudson River	Two following points probably from same locality	N. Y. State Museum #36405-1	Mottled light and dark brown jasper	3 11/32″ 85 mm.	1 1/8″ 29 mm.	11/32″ 9 mm.	Parallel sided	Both faces, c. 1/2 and 2/3	Lower edges and base	Fine	Plates 1 A, B, figures F, f. Similar to example from Crumhorn Mountain. (See plate 1 A, B, figures G, g)
8	"	"	"	"	See last entry	N. Y. State Museum #36405-2	Mottled gray and greenish flint (Deepkill)	3 7/32″ 82 mm.	1 3/16″ 30 mm.	9/32″ 7 mm.	Lower edges slightly incurvate	Both faces, c. 1/3	Lower edges and base (slightly)	"	Plates 1 A, B, figures H, h

TABL[E]

Location, Source and Description o[f]

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
19	Greene	Coxsackie	Vicinity of Coxsackie	Probably high level fields along Hudson River	See two last entries	N. Y. State Museu[m] #36405-3
11	Albany	Colonie	Harold Smith farm, West Albany	Sand ridge along Shaker Road	None	Carl S. Sundler
	"	"	West Albany	Sandy ridge	"	"
21	Saratoga	Northumberland	Henry Peck farm, c. ¼ mile north of Bacon Hill	High level field c. ¾ mile west of Hudson River	"	N. Y. State Museum #39986
	"	Wilton	Near village of Wilton	Probably on headwaters of Little Snook Kill, near eastern flank of Palmertown Range, some 8 miles in air line west of Hudson River	—	Southwest Museum Los Angeles, Calif #1018-C-1 (Brill coll.
52	Suffolk	Southold	Old Wickham farm, Pipes Neck Creek, Greenport, Long Island	From flat cultivated field adjoining tidal creek	Artifacts of several cultures found here	Roy Latham, #37
51	"	Southampton	Near old "Spider Legged Mill," about 3 miles northwest of Bridgehampton	Found about 1942 by J. F. Raynor on newly cleared plowed land, on high ground (Ronkonkoma morainal ridge)	No other artifacts from entire field	Joseph F. Rayno[r] Hampton Bays, N. Y
	Cattaraugus	Little Valley	E. E. Mackey farm, near Little Valley	—	—	Walter Tennies Lakewood, N. Y.

(*continued*)

luted Points from New York State

	DESCRIPTION							
Material	SIZE (in. and mm.)			Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
	L.	B.	T.					
ark gray flint)nondaga)	$4\frac{3}{16}''$ 107 mm.	$1\frac{9}{16}''$ 40 mm.	$\frac{1}{4}''$ 6 mm.	Parallel sided	Both faces, full and c. $\frac{2}{3}$	Lower edges and base	Fine	Plates 3 A, B, figures C, c. Largest point in New York series
uartzite, peculiar having second- ·y silica around ıch grain	$1\frac{5}{8}''$ 41 mm.	$1''$ 25.4 mm.	$\frac{7}{32}''$ 5 mm.	Lower edges slightly incurvate	Full on both faces	Too badly weathered to determine	Fair	Plates 2 A, B, figures B, b. Most deeply weathered point seen. Tip of point broken. Carl S. Sundler, West Albany, N. Y.
ireenish flint Normanskill)	—	—	—	—	—	—	—	Fragmentary blade section
)ark gray flint probably Fort .nn)	$2\frac{21}{32}''$ 67 mm.	$\frac{15}{16}''$ 24 mm.	$\frac{9}{32}''$ 7 mm.	Lower edges slightly incurvate	Both faces, full and c. $\frac{1}{2}$	Lower sides and base (slight)	Poor	Plates 3 A, B, figures E, e. Gift of Louis E. Follette, Schuylerville, N. Y.
)ark greenish flint probably Nor- ıanskill)	$2\frac{7}{16}''$ 62 mm.	$1''$ 25.4 mm.	— —	One lower edge slightly incurved	Both faces, c. $\frac{2}{3}$	—	Fair	Weathered flint
Mottled creamy white and chest- ıut brown flint	$2''$ 51 mm.	$1\frac{3}{16}''$ 30 mm.	$\frac{5}{16}''$ 8 mm.	Lower edges slightly incurvate	Both faces, c. $\frac{1}{2}$ and $\frac{2}{3}$	Lower sides and base	Good	Plates 10 A, B, figures E, e. Also illustrated in Fowler, 1954, figure 2, 9. Data from Roy Latham, Orient, N. Y.
)live green flint probably Deep- kill)	$2\frac{13}{16}''$ 71 mm.	$1\frac{9}{32}''$ 32.5 mm.	$\frac{9}{32}''$ 7 mm.	Parallel sided	Both faces, c. $\frac{5}{6}$ and $\frac{2}{3}$	Lower sides and base	Good	Plates 10 A, B, figures D, d. Moderate degree of weathering.
Dark blue-gray mottled flint (On- ondaga?)	$2\frac{3}{16}''$ 56 mm.	$1''$ 25.4 mm.	— —	Broad lanceolate, aberrant form	One face, c. $\frac{2}{3}$	Lower sides and base	"	Illustrated in Mayer-Oakes, 1955, plate 1, B (and p. 44)

TABLE 1 (*continued*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION					SOURCE	DESCRIPTION								
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number	Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
19	Greene	Coxsackie	Vicinity of Coxsackie	Probably high level fields along Hudson River	See two last entries	N. Y. State Museum #36405-3	Dark gray flint (Onondaga)	4 3/16″ 107 mm.	1 9/16″ 40 mm.	1/4″ 6 mm.	Parallel sided	Both faces, full and c. 2/3	Lower edges and base	Fine	Plates 3 A, B, figures C, c. Largest point in New York series
11	Albany	Colonie	Harold Smith farm, West Albany	Sand ridge along Shaker Road	None	Carl S. Sundler	Quartzite, peculiar in having secondary silica around each grain	1 5/8″ 41 mm.	1″ 25.4 mm.	7/32″ 5 mm.	Lower edges slightly incurvate	Full on both faces	Too badly weathered to determine	Fair	Plates 2 A, B, figures B, b. Most deeply weathered point seen. Tip of point broken. Carl S. Sundler, West Albany, N. Y.
	"	"	West Albany	Sandy ridge	"	"	Greenish flint (Normanskill)	—	—	—	—	—	—	—	Fragmentary blade section
21	Saratoga	Northumberland	Henry Peck farm, c. 1/4 mile north of Bacon Hill	High level field c. 3/4 mile west of Hudson River	"	N. Y. State Museum #39986	Dark gray flint (probably Fort Ann)	2 21/32″ 67 mm.	15/16″ 24 mm.	9/32″ 7 mm.	Lower edges slightly incurvate	Both faces, full and c. 1/2	Lower sides and base (slight)	Poor	Plates 3 A, B, figures E, e. Gift of Louis E. Follette, Schuylerville, N. Y.
	"	Wilton	Near village of Wilton	Probably on headwaters of Little Snook Kill, near eastern flank of Palmertown Range, some 8 miles in air line west of Hudson River	—	Southwest Museum, Los Angeles, Calif. #1018-C-1 (Brill coll.)	Dark greenish flint (probably Normanskill)	2 7/16″ 62 mm.	1″ 25.4 mm.	— —	One lower edge slightly incurved	Both faces, c. 2/3	—	Fair	Weathered flint
52	Suffolk	Southold	Old Wickham farm, Pipes Neck Creek, Greenport, Long Island	From flat cultivated field adjoining tidal creek	Artifacts of several cultures found here	Roy Latham, #37	Mottled creamy white and chestnut brown flint	2″ 51 mm.	1 3/16″ 30 mm.	5/16″ 8 mm.	Lower edges slightly incurvate	Both faces, c. 1/2 and 2/3	Lower sides and base	Good	Plates 10 A, B, figures E, e. Also illustrated in Fowler, 1954, figure 2, 9. Data from Roy Latham, Orient, N. Y.
51	"	Southampton	Near old "Spider Legged Mill," about 3 miles northwest of Bridgehampton	Found about 1942 by J. F. Raynor on newly cleared plowed land, on high ground (Ronkonkoma morainal ridge)	No other artifacts from entire field	Joseph F. Raynor, Hampton Bays, N. Y.	Olive green flint (probably Deepkill)	2 13/16″ 71 mm.	1 9/32″ 32.5 mm.	9/32″ 7 mm.	Parallel sided	Both faces, c. 5/6 and 2/3	Lower sides and base	Good	Plates 10 A, B, figures D, d. Moderate degree of weathering.
	Cattaraugus	Little Valley	E. E. Mackey farm, near Little Valley	—	—	Walter Tennies, Lakewood, N. Y.	Dark blue-gray mottled flint (Onondaga?)	2 3/16″ 56 mm.	1″ 25.4 mm.	— —	Broad lanceolate, aberrant form	One face, c. 2/3	Lower sides and base	"	Illustrated in Mayer-Oakes, 1955, plate 1, B (and p. 44)

TABL

Location, Source and Description o

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
	Cattaraugus	Cold Spring	Cold Spring, Allegany Seneca Reservation	—	—	William J. Congdo Hopewell, Va.
	"	South Valley	Near Onoville	—	—	—
	Chautauqua	Kiantone	At junction of Kiantone and Conewango Creeks (Mayer-Oakes site 30 Ch. 8)	Low, level land	Mixed surface material, Archaic and Late Woodland. Following point from same site	Walter Tennie Lakewood, N. Y.
	"	"	"	"	See last entry	"
	"	—	Shore of Chautauqua Lake	—	—	W. T. Fenton Col U. S. National M seum
	"	—	c. 3 miles south of Jamestown	—	—	—
	"	Ellington	Anderson farm, between Clear Creek and Ellington	Low land along Clear Creek	May have been in refuse pit with crude plain pottery	Eber L. Russell, Pe rysburg, N. Y.
50	"	Busti Lot 36	Near Busti	c. 30 feet above edge of Stillwater Creek (south side)	Few small weathered flint flakes nearby in same erosion-loosened soil beneath sod	Waldo P. Stanfor Mayville, N. Y.
49	Erie	Collins	Flats on north side Cattaraugus Creek, just west of Gowanda city limits	Low land along Cattaraugus Creek	—	Stuart Spittler, Go anda, N. Y.

(continued)

ıted Points from New York State

	DESCRIPTION								
Material	SIZE (in. and mm.) L.	B.	T.	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
ıy flint (prob-ıy Onondaga)	—	—	—	Lower edges contracted to form weak stem	One face	—	Good	Illustrated in Mayer-Oakes, 1955, plate 3, C (and page 46)
—	—	—	—	—	—	—	Fair	Illustrated in Mayer-Oakes, 1955, plate 8, E
ıy flint	1¾″ 44.5 mm.	11/16″ 17 mm.	— —	Parallel sided	One face, c. ⅔	None	Poor	Illustrated in Mayer-Oakes, 1955, plate 1, A (and p. 44)
ɔttled gray and ı flint (probably ondaga)	1 13/16″ 46 mm.	¾″ 19 mm.	— —	"	Both faces, c. ½	Lower edges and base	"	Illustrated in Mayer-Oakes, 1955, plate 1, C (and p. 44)
ay-brown flint ıondaga?)	—	—	—	"	Both faces, c. ⅔ and full	—	Fair	See Mayer-Oakes, 1955, plate 3, B and p. 46
ɔwn flint	—	—	—	—	—	—	—	—
ll gray flint	3″ 76 mm.	1¼″ 32 mm.	—	Parallel sided	Both faces, c. ½	Lower edges and base	Good	See illustration in Russell, 1952, pp. 5–7
;ht gray flint estern Ononda-)	2 15/16″ 74 mm.	1 7/16″ 36.5 mm.	3/16″ 5 mm.	Obovate	Both faces, c. ¾ and ⅓	Lower edges and base	Excellent	Plates 10 A, B, figures C, c. Data from W. P. Stanford and W. H. Glover, Buffalo Historical Society. An aberrant form.
ɔttled gray and ı flint (western ondaga)	2 7/16″ 62 mm.	1″ 25.4 mm.	¼″ 6.5 mm.	Lower edges slightly incurvate	Full on both faces	"	"	Plates 10 A, B, figures B, b. Data from Alfred K. Guthe, Rochester Museum of Arts & Sciences and Stuart Spittler.

TABLE 1 (*continued*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION: County	LOCATION: Township and Lot	LOCATION: Locus	LOCATION: Terrain	LOCATION: Association	SOURCE: Collection and Catalog Number	DESCRIPTION: Material	Size L. (in. and mm.)	Size B. (in. and mm.)	Size T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
	Cattaraugus	Cold Spring	Cold Spring, Allegany Seneca Reservation	—	—	William J. Congdon Hopewell, Va.	Gray flint (probably Onondaga)	—	—	—	Lower edges contracted to form weak stem	One face	—	Good	Illustrated in Mayer-Oakes, 1955, plate 3, C (and page 46)
	"	South Valley	Near Onoville	—	—	—	—	—	—	—	—	—	—	Fair	Illustrated in Mayer-Oakes, 1955, plate 8, E
	Chautauqua	Kiantone	At junction of Kiantone and Conewango Creeks (Mayer-Oakes site 30 Ch. 8)	Low, level land	Mixed surface material, Archaic and Late Woodland. Following point from same site	Walter Tennies Lakewood, N. Y.	Gray flint	1 3/4″ 44.5 mm.	11/16″ 17 mm.	— —	Parallel sided	One face, c. 2/3	None	Poor	Illustrated in Mayer-Oakes, 1955, plate 1, A (and p. 44)
	"	"	"	"	See last entry	"	Mottled gray and tan flint (probably Onondaga)	1 13/16″ 46 mm.	3/4″ 19 mm.	— —	"	Both faces, c. 1/2	Lower edges and base	"	Illustrated in Mayer-Oakes, 1955, plate 1, C (and p. 44)
	"	—	Shore of Chautauqua Lake	—	—	W. T. Fenton Coll., U. S. National Museum	Gray-brown flint (Onondaga?)	—	—	—	"	Both faces, c. 2/3 and full	—	Fair	See Mayer-Oakes, 1955, plate 3, B and p. 46
	"	—	c. 3 miles south of Jamestown	—	—	—	Brown flint	—	—	—	—	—	—	—	—
	"	Ellington	Anderson farm, between Clear Creek and Ellington	Low land along Clear Creek	May have been in refuse pit with crude plain pottery	Eber L. Russell, Perrysburg, N. Y.	Dull gray flint	3″ 76 mm.	1 1/4″ 32 mm.	—	Parallel sided	Both faces, c. 1/2	Lower edges and base	Good	See illustration in Russell, 1952, pp. 5–7
50	"	Busti Lot 36	Near Busti	c. 30 feet above edge of Stillwater Creek (south side)	Few small weathered flint flakes nearby in same erosion-loosened soil beneath sod	Waldo P. Stanford Mayville, N. Y.	Light gray flint (western Onondaga)	2 15/16″ 74 mm.	1 7/16″ 36.5 mm.	3/16″ 5 mm.	Obovate	Both faces, c. 3/4 and 1/3	Lower edges and base	Excellent	Plates 10 A, B, figures C, c. Data from W. P. Stanford and W. H. Glover, Buffalo Historical Society. An aberrant form.
49	Erie	Collins	Flats on north side Cattaraugus Creek, just west of Gowanda city limits	Low land along Cattaraugus Creek	—	Stuart Spittler, Gowanda, N. Y.	Mottled gray and tan flint (western Onondaga)	2 7/16″ 62 mm.	1″ 25.4 mm.	1/4″ 6.5 mm.	Lower edges slightly incurvate	Full on both faces	"	"	Plates 10 A, B, figures B, b. Data from Alfred K. Guthe, Rochester Museum of Arts & Sciences and Stuart Spittler.

TAB

Location, Source and Description

Plate Caption Numbers	LOCATION					SOURCE
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number
48	Erie	North Collins	Alfred J. Musacchio farm, ½ mile north of Lawtons on Gowanda State Rd.	Low, level ground, heavy clay soil, not near waterway	No other artifacts in general vicinity	Alfred J. Musacc State Rd., Lawto N. Y.

(concluded)

luted Points from New York State

DESCRIPTION

Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Work-manship	Addenda and Acknowledgments
ark blue-black int (Upper Mer-er?)	3⅙″(est.) 1⅙″ 5/16″ 76 mm. 27 mm. 8 mm. (est.)	Parallel sided	Both faces, c. ¼	Lower edges and base	Fair	Plates 10 A, B, figures A, a. Data from W. H. Glover, Buffalo Hist. Soc., and A. J. Musacchio. Found on surface after tilling ground. Tip may have been broken in digging trench 2–3½ feet deep.

Table 1 (*concluded*)

Location, Source and Description of Fluted Points from New York State

Plate Caption Numbers	LOCATION					SOURCE	DESCRIPTION						
	County	Township and Lot	Locus	Terrain	Association	Collection and Catalog Number	Material	Size L. B. T. (in. and mm.)	Form	Fluting	Grinding	Workmanship	Addenda and Acknowledgments
48	Erie	North Collins	Alfred J. Musacchio farm, ½ mile north of Lawtons on Gowanda State Rd.	Low, level ground, heavy clay soil, not near waterway	No other artifacts in general vicinity	Alfred J. Musacchio, State Rd., Lawtons, N. Y.	Dark blue-black flint (Upper Mercer?)	3⅙″(est.) 1⅙″ 5/16″ 76 mm. 27 mm. 8 mm. (est.)	Parallel sided	Both faces, c. ¼	Lower edges and base	Fair	Plates 10 A, B, figures A, a. Data from W. H. Glover, Buffalo Hist. Soc., and A. J. Musacchio. Found on surface after tilling ground. Tip may have been broken in digging trench 2–3½ feet deep.

Mohawkian (Middle Ordovician) Biostratigraphy of the Wells Outlier Hamilton County, New York

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CONTENTS

ILLUSTRATIONS

Panorama taken from the summit of West Hill looking north along the valley formed by the Wells graben. Precambrian ridges flank the graben on the left (west) and right (east) while Algonquin Lake, visible in the center of the picture, occupies the floor of the Paleozoic valley.

MOHAWKIAN (MIDDLE ORDOVICIAN) BIOSTRATIGRAPHY OF THE WELLS OUTLIER HAMILTON COUNTY, NEW YORK*

By
DONALD W. FISHER
State Paleontologist

Abstract

The occurrence of a mixed Chaumont-Selby (Uppermost Black River-Lowermost Trenton of Kay, 1937) faunal assemblage within a single lithologic unit in the Middle Ordovician carbonate sequence at the Wells outlier, Hamilton County, New York, necessitates restudy of the faunal succession. Lithogenetic units and their faunas are described in greater detail than previously. Ecologic control is suggested as bringing about a biostatigraphic zonation in the type areas of the Chaumont and Selby limestones in the Black River Valley whereas the restricting factor, postulated to be temperature change, was not effective in producing this separation in the Wells region. The Adirondack area is regarded as being inundated and receiving sediments up through mid-Trenton (Utica-Canajoharie) time but with an earlier emergence following the Early Ordovician (Canadian). From the economic standpoint, the rocks and surficial deposits within the Wells outlier may serve local needs but larger operations are not considered practicable.

* Manuscript submitted for publication, January 26, 1955.

INTRODUCTORY REMARKS

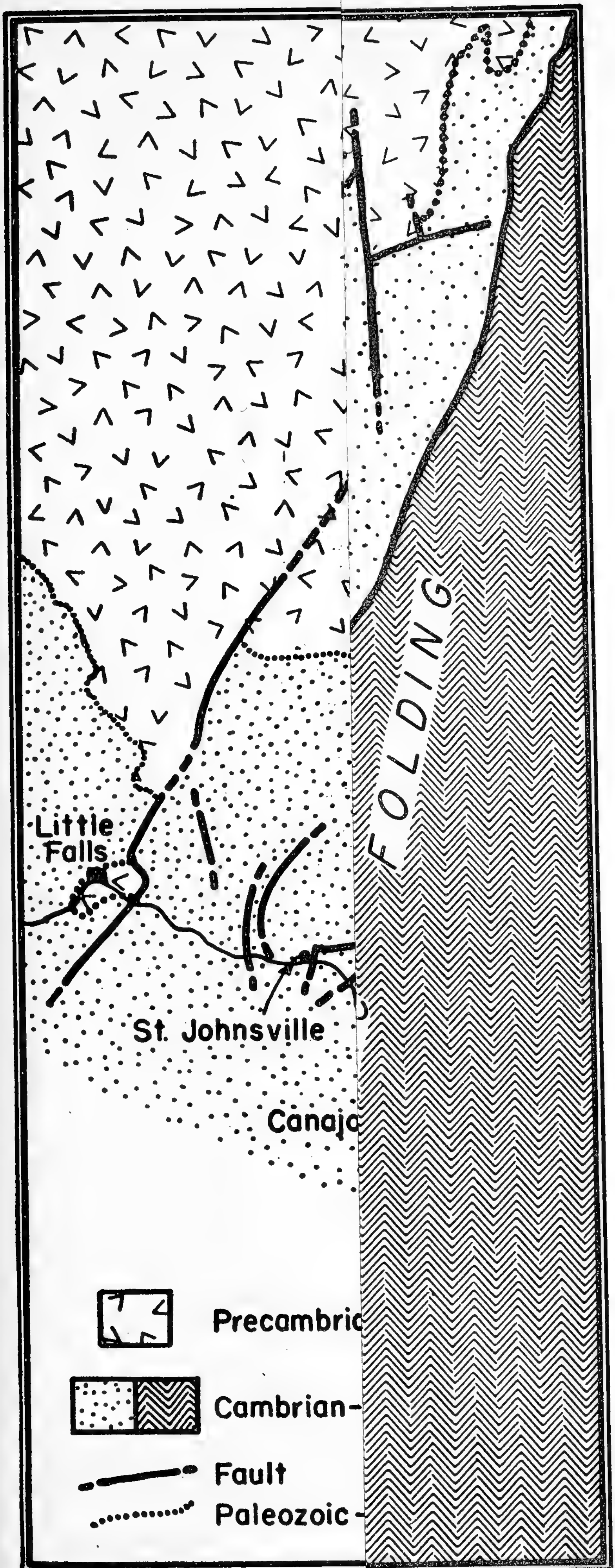
Location and Geologic Setting. The Wells outlier, intriguing because of its occurrence, that of Lower Paleozoic unmetamorphosed strata well within the peripheral border of the metamorphosed Precambrian Adirondack Mountains, occurs at Wells, Hamilton County, New York. This is in the northeastern quadrant of the 15-minute Lake Pleasant quadrangle and is 24 miles (airline) north of Gloversville and 33 miles (airline) west of Glens Falls (figure 1).

These outlying Cambrian-Ordovician sedimentary rocks owe their preservation to normal faulting which has downdropped the section, forming a graben 4.5 miles in a north-south direction and 1.4 miles at its widest point: the strata underlie an area of about 3.5 square miles (figure 2). Bounding this graben, which exhibits the most complete Paleozoic section within the Adirondack Mountains, are normal high-angle faults. The boundary faults have a large displacement, impossible to estimate due to the absence of key beds in the Precambrian foot walls.

On the west occurs the prominent Elbow-Three Ponds Mountain fault, upthrown on the west, which is considered the northern extension of the major St. Johnsville fault of the Mohawk Valley. An easterly upthrown normal fault delimits the graben on the east. A minor fault bisects the outlier in a northeast-southwest direction while two short, but major, cross-faults mark the southern boundary. The Wells outlier is a northern manifestation of the Mohawk Valley block faulting.

Similar outliers occur at Hope, Piseco Lake, 2.5 miles north of Thirteenth Lake (20 miles east-northeast of Wells), and at Lake George. The allochthonous Cambrian and Ordovician strata involved in severe Taconic folding occur too far to the east and are too lithologically dissimilar for these Adirondack outliers to be regarded as erosional remnants of this overthrust mass. The outliers are unquestionably genetically related to the graben and horst topography of the Mohawk Valley.

Glacial erosion and deposition during the last Ice Age (Pleistocene) have exerted a noticeable effect on the topography of the Wells region. The east branch of the Sacandaga River occupies the valley of less resistant Paleozoic strata. It was through this valley that trunk glaciers, as they melted, left the splendid kame topography which is so well displayed between Wells Lake (Algonquin Lake), a shallow artificial lake, and the imposing ridge west of the village of Wells. Boulder moraine floors the remainder of the valley. The combination of glacial deposits, together with the artificial lake, affords few bedrock exposures of Paleozoic strata.



FOLDING
Little Falls
St. Johnsville
Canajo
Precambric
Cambrian-
Fault
Paleozoic-

Figure

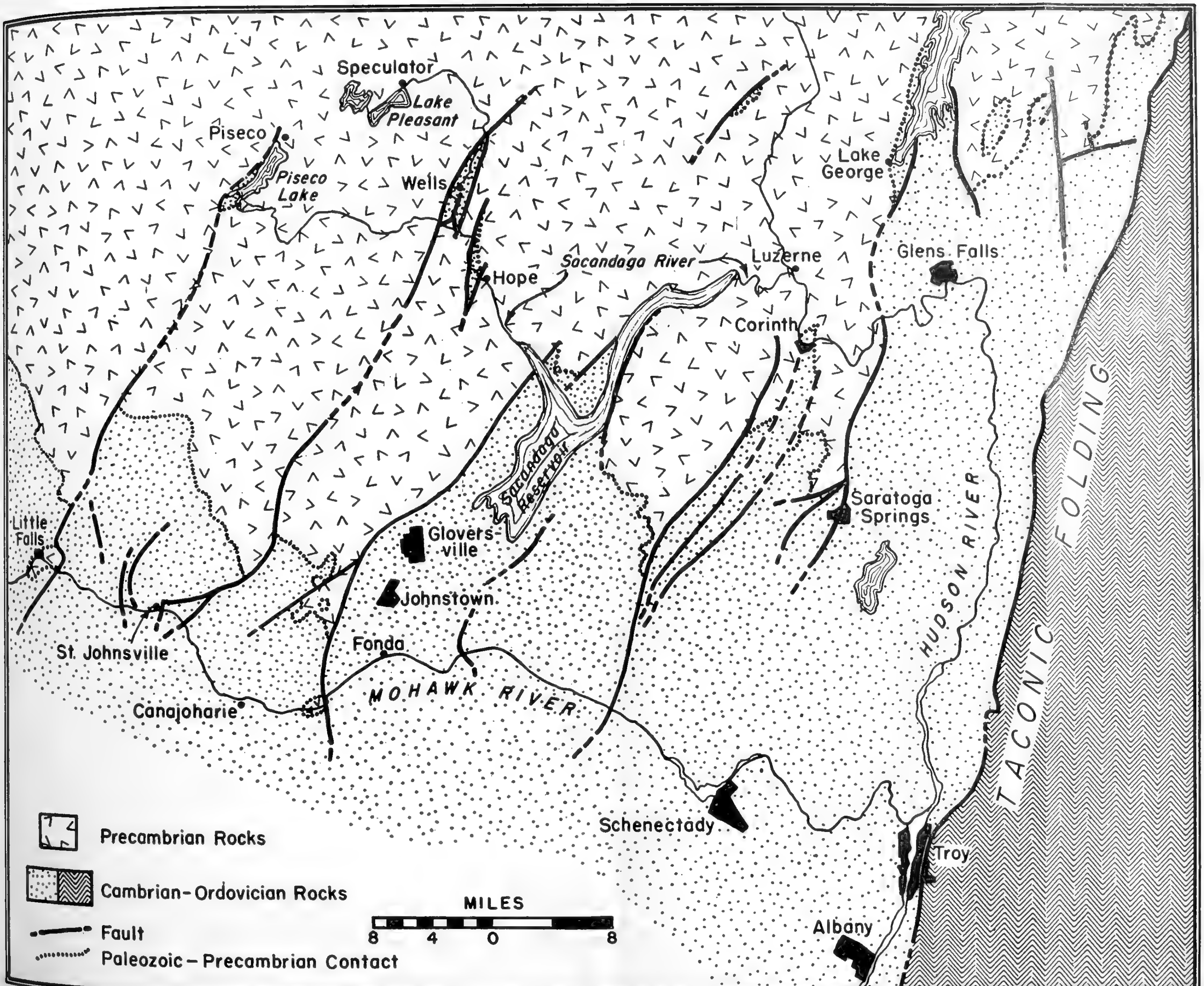


Figure 1. Sketch map depicting the geographic and geologic relationships of the Wells outlier to the Mohawk and Hudson Valleys.

Previous work. The existence of the Wells outlier, largest within the Adirondack Mountains, has been known for over 100 years. Emmons (1842, p. 417) reported its presence in the *Geology of the Second District,* though Vanuxem is reputed to have been the first to discover it. Darton (1893, p. 415) briefly mentioned the Wells outlier in a progress report of preliminary work in the Mohawk Valley. Kemp, Newland and Hill (1898, pp. 143-152) presented a splendid preliminary study of the area in connection with reconnaissance work in Hamilton County. Their treatment deals primarily with the petrology of the rocks. Ruedemann (1898, p. 75) mentioned the region in supporting his view that the southern Adirondacks, at least, were covered by Late Cambrian and Middle Ordovician seas. In *The Geology of the Lake Pleasant Quadrangle,* Miller (1916, pp. 32-41) emphasized the structural relations of the Wells outlier. In a detailed analysis of the Trenton group, Kay (1937, p. 256) reported that the Napanee member of the Rockland formation of Early Trenton age was represented by 10 feet of limestone at the Wells outlier.

Purpose of this work. While seeking exposures of the Amsterdam limestone, for a biostratigraphic and lithostratigraphic study of that formation, the writer fortunately discovered what proved to be a previously unrecognized fauna in a gray-black (N2)[1] cherty argillicalcilutite directly overlying the Lowville limestone. Miller (1916, p. 37) had reported the Leray (?) limestone at Wells but listed no fossils and it was uncertain whether this was the interval referred to by him. It was felt that a detailed study would disclose further information pertaining to paleoecology, paleogeography and the ages of the lithologic units because of subsequent refinements in Trentonian stratigraphy in New York and because biostratigraphic consideration of the carbonate rocks within the Wells outlier has received only cursory attention. Furthermore, the interest which these Paleozoic outliers afford can be likened to that of Precambrian inliers such as those at Little Falls and at the "Noses," midway between Canajoharie and Fonda (see figure 1).

Acknowledgments. The writer is indebted to John Heller, staff photographer of the New York State Museum, who photographed the fossils and pictorial scenes. Preparatory to photographing, the fossils were coated with ammonium chloride to enhance the details.

[1] Colors referred to are taken from the National Research Council's "Rock Color Chart" (1951), accepted as a standard by many.

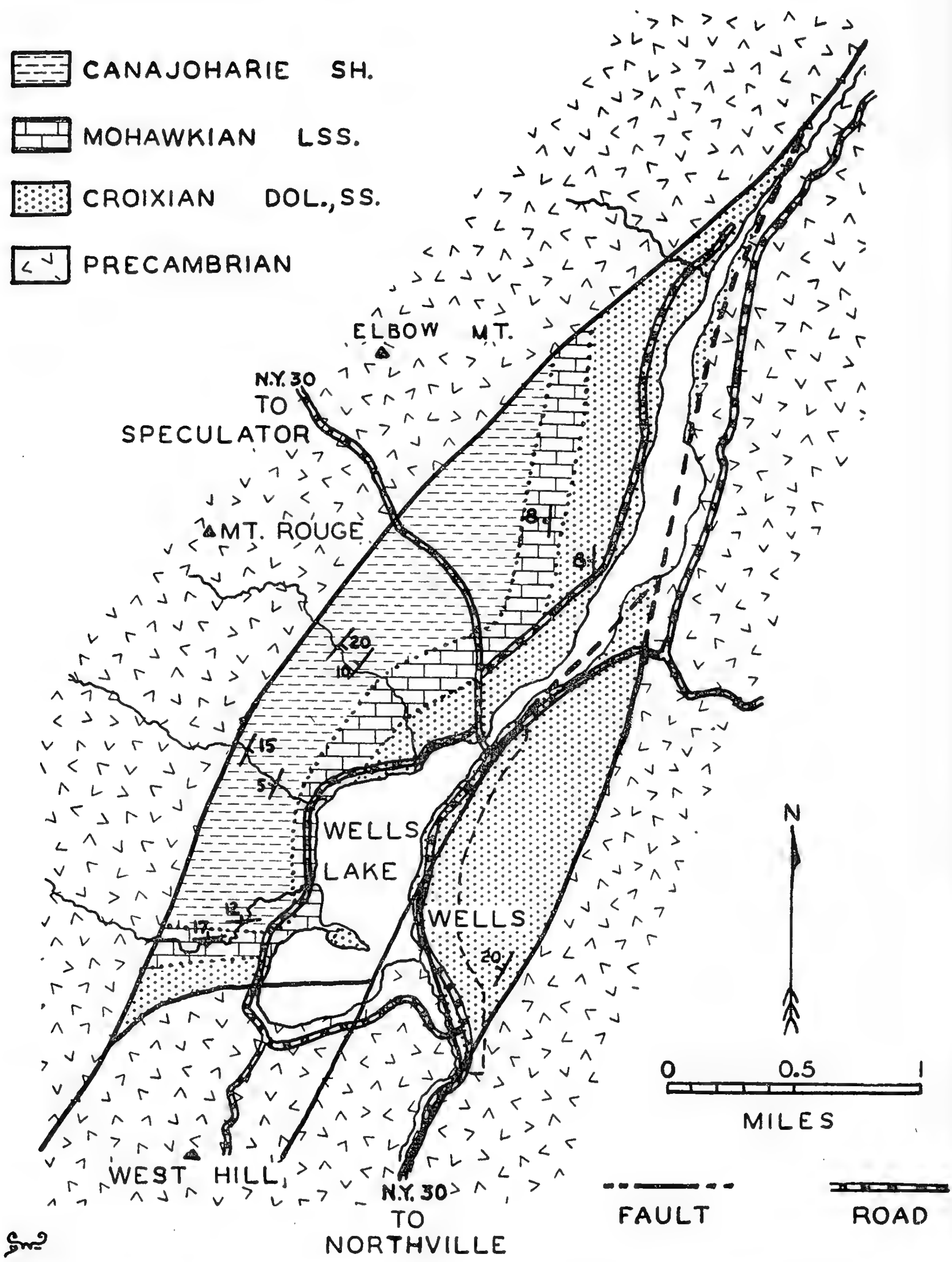


Figure 2. Geologic sketch map of the Wells outlier, Hamilton County, N. Y.

PRE-MOHAWKIAN STRATA

Upper Cambrian (?) strata. The pre-Lowville beds have furnished no fossils; consequently their exact age is indeterminable. Yellowish-gray (5Y 8/1), medium-textured sandstone, markedly like the Potsdam and Galway sandstones of the Saratoga Springs region, appears sparingly within the infaulted outlier. The Potsdam outcrops mentioned by Kemp, Newland and Hill (1898, p. 147) are no longer visible. Sandy dolomite, bluish-gray (5B 6/1) on fresh fracture and weathering yellowish-gray (5Y 7/2), analogous to that of the Galway formation, also outcrops infrequently. No outcrop of rocks displaying these lithologies could be found that showed more than 4 feet of exposure.

The cherty light bluish-gray (5B 7/1) dolomite which is widely exposed near the cemetery, east of N. Y. Route 30 in the village of Wells, may be a northern manifestation of the upper cherty Little Falls dolomite of the Mohawk Valley, although confirmation of such a correlation is wanting. After careful search, no *Cryptozoon* remains were found. It is conceivable that this and the older clastic beds may be Canadian in age; less likely that they are Chazyan. Whereas Canadian dolomites wedge out a short distance north of the Mohawk Valley, it is admissible that, owing to a fortuitous chance of preservation, an isolated remnant may occur. The nearest Chazyan rocks outcrop over 90 miles to the northeast and the intervening sections at Glens Falls and at Smith Basin (10 miles northeast of Glens Falls) show Mohawkian limestones lying disconformably on Canadian strata. In lieu of paleontologic evidence, lithic identity favors a Late Cambrian age for the pre-Mohawkian strata within the Wells outlier.

MOHAWKIAN STRATA[1]

Lowville limestone. The oldest proved Mohawkian stratigraphic unit in the Wells region is the Lowville limestone of the Black River group. The formation was formerly referred to as the "Birdseye limestone," a name given by the early workers because of the similarity of the cross sections of the worm boring *Phytopsis* to birds' eyes. The limestone was named from the excellent exposures at Lowville, Lewis County, N. Y.

West of the county road, along the west shore of Algonquin Lake and along the extreme southern belt of limestone exposure, 12 feet of typical chalk-white weathering, "dove-gray," massive calcilutite out-

[1] Since this article was submitted for publication, G. A. Cooper, in "Chazyan and related brachiopods" (1956), has proposed a new division of the Mohawkian, making the Shoreham the base of the Trenton.

crops along the most southerly unnamed stream entering Algonquin Lake from the west (Plate Ia). The rock is medium dark gray (N4) to medium gray (N5) on fresh fracture and weathers from a very light gray (N8) to chalk-white (N9).

Two lithofacies are exhibited though there is intergradation between them. The medium gray ("dove") sublithographic limestone is characterized by a fine display of cross sections of the worm burrow *Phytopsis tubulosus* Conrad (plate Ib). Some *Phytopsis* tubes were as much as 10 inches long. A diameter of 0.5 inch is almost universal. Secondary calcite with a megascopic "shredded" appearance occupies the fillings. Other fossils are exceedingly rare in this lithofacies.

The other lithofacies is a darker gray, darker weathering, sublithographic limestone, more fossiliferous than the *Phytopsis*-bearing facies and seemingly lacking it. The peculiar coral, *Tetradium cellulosum* (Hall), characterizes this facies along with gastropods, cephalopods and brachiopods. The larger faunal content undoubtedly accounts for the darker color of the rock. Both lithologic types are regarded as chemical precipitates in very shallow water because mud cracks are present, particularly in the "dove" facies. Thin seams of pebble conglomerate and large rounded quartz-sand grains occasionally occur within the Lowville. The two lithofacies denote differing physical environments (lithotopes) while the contrasting faunal associations (biofacies) reflect the selectivity of the organisms for their respective faunal environments (biotopes).

As the base of the Lowville was not observed, nothing definite can be stated with regard to the Croixian-Mohawkian contact. Presumably, it must be a disconformable surface since the Chazyan and Canadian strata are wanting from their accustomed stratigraphic position. The upper contact of the Lowville is perfectly conformable, but with a sharp lithologic change, with the overlying Chaumont limestone. A dip of 17° NNW, at the sole exposure of the Lowville, indicates proximity to a southern cross fault (plate Ia).

The following fossils were observed in the Lowville limestone. Relative abundancy of species is indicated as follows: a = abundant, c = common, s = scarce, r = rare.

Worm burrow:
- a *Phytopsis tubulosus* Conrad

Corals:
- r *Lambeophyllum profundum* (Conrad)
- c *Tetradium cellulosum* (Hall)

Bryozoa:
- s *Rhinidictya* sp.

Brachiopoda:
- s *Strophomena* sp.
- s *Zygospira recurvirostra* (Hall)

Pelecypoda:
- r *Cyrtodonta* cf. *huronensis* Billings

Gastropoda:
- c *Lophospira perangulata* (Hall)
- s *Raphistomina* sp.
- c *Trochonema umbilicata* Hall

Cephalopoda:
- r *Cycloceras* sp.
- s *Michelinoceras multicameratum* (Emmons)

Chaumont limestone. At the same locality at which the Lowville is exposed, there is a 9-foot thickness of massive, blocky, argilli calcilutite with much black chert. On fresh fracture, the rock is grayish-black (N2) to dark gray (N3) while it is light (N7) to medium light gray (N6) on a weathered surface. Bedding is indistinct. Presumably, this is the interval referred to as Black River (Leray) limestone by Miller (1916, p. 37).

The affinity of this unit with the Chaumont (pronounced Shŭ-mṓ) limestone of the Black River Valley is demonstrated paleontologically. It is post-Lowville and pre-Napanee ("Upper" Rockland) for it overlies undoubted *Phytopsis*-bearing Lowville limestone and underlies *Triplesia cuspidata*-bearing limestone, indicative of the Napanee. According to the standard section, the unit may be referable to either a late Black River (Chaumont) or Early Rockland (Selby) age.

The Chaumont limestone in the Black River Valley is distinguished by the preponderance of nautiloid cephalopods, together with the presence of the stromatoporoid *Stromatocerium rugosum* Hall, the corals *Favistella halli* (Nicholson) and *Lambeophyllum profundum* (Conrad), and species of the brachiopods *Hesperorthis* and *Rhynchotrema*. Furthermore, the trilobites *Illaenus latiaxiatus* Raymond and Narraway and *Ceraurinus scofieldi* (Clarke) are restricted to the Chaumont (Young, 1943, p. 240).

On the other hand, the Selby member of the Trentonian Rockland formation is typified by the brachiopod *Doleroides ottawanus* Wilson and the associated ubiquitous Trenton species, *Sowerbyella curdsvillensis* (Foerste), *Resserella rogata* (Sardeson), *Rafinesquina alternata* (Conrad) and *Flexicalymene*[1] *senaria* (Hall). The coral *Favistella halli* (Nicholson) and the cephalopod *Gonioceras* are also present. *Onco-*

[1] The name *Orimops* Rafinesque 1832 has precedence over *Flexicalymene* Shirley 1936.

ceras collinsi Foerste is a common cephalopod in the type section (Kay, 1937, p. 255).

Although the Chaumont and Selby are lithologically indistinguishable along Mill Creek at Lowville, they can be differentiated faunally. In reality, then, two faunal zones (biostratigraphic units) exist within a single lithofacies. Such a distinction is not possible at Wells. In contrast, the unit in question possesses faunal elements supposedly typifying both Chaumont and Selby limestones! Here we have a merging of certain constituents of the type Chaumont biofacies and the type Selby biofacies into a single biotope. Whereas the Selby "index" fossils, *Doleroides ottawanus* and *Oncoceras collinsi* were found at Wells, the failure to find *Sowerbyella, Resserella* and *Orimops* (*"Flexicalymene"*) strongly implies a pre-Trentonian age. Moreover, the presence of several genera of nautiloid cephalopods, so distinctive of the Chaumont environment, favors a late Black River age. It appears that either the Selby "index" fossils have a longer time span than was previously recognized or else the Chaumont and Selby faunas are actually time-equivalent and merely represent two environments with ecologic control more clearly defined in the Black River Valley than in the Wells region. Some determinative factor of distribution, such as temperature change, may have accounted for the separation of the faunas in one area and the partial mixing of them in another. Some species are rigidly confined by temperature limits whereas a slight rise or fall of thermal gradient may permit other species to venture into an adjacent environment. At any rate, it seems likely that there is no sharp line of demarcation between late Black River and early Trenton faunas and that the apparent differences can be explained by ecologic control.

A noteworthy feature of the Chaumont limestone at Wells is the existence of silicified fossils. They seem to be independent of the chert nodules. Two periods of silicification are suggested. In the writer's opinion, the black chert nodules are penecontemporaneous with limestone deposition while a later redistribution of silica caused replacement of some of the fossils. Only some of the gastropods, cephalopods, brachiopods, corals and bryozoa were thus affected.

Whether the Chaumont limestone at Wells consists of the Leray or Watertown members, or includes both, cannot be determined with assurance. Young, who made the most comprehensive study of the Black River group (1943, p. 210), states that the members are not distinguishable outside of their respective type areas. Though chert is more abundant in the Leray in that area, it is not a reliable criterion to use except where comparative ratios can be obtained.

Anthozoa:
- r *Lambeophyllum profundum* (Conrad)

Bryozoa:
- s *Pachydictya* sp.
- s Other genera not determined

Brachiopoda:
- s *Doleroides ottawanus* Wilson
- s *Hesperorthis tricenaria* (Conrad)
- s *Rafinesquina* sp.
- r *Rhynchotrema* cf. *increbescens* (Hall)
- s *Zygospira recurvirostra* (Hall)

Gastropoda:
- r *Cyrtodiscus* sp.
- s *Helicotoma planulata* (Salter)
- s *Holopea symmetrica* Hall
- s *Liospira lenticularis* (Emmons)
- c *Lophospira perangulata* Hall
- s *Trochonema umbilicata* (Hall)

Pelecypoda:
- r *Clionychia lamellosa* (Hall)
- r *Ctenodonta* sp.

Cephalopoda:
- c *Actinoceras tenuifilum* Hall
- s *"Cycloceras" arcuoliratus* Hall
- c *Endoceras proteiforme* Hall
- s *Geisenoceras* sp.
- r *Gonioceras anceps* Hall
- c *Michelinoceras* sp.
- s *Oncoceras collinsi* Foerste
- s *Plectoceras undatus* (Conrad)
- r *Sactoceras* sp.
- r *Spyroceras sp.*

Trilobita:
- c *Bathyurus extans* (?) (Hall)
- s *Bathyurus spiniger* Hall
- s *Illaenus* cf. *conradi* Billings

Ostracoda:
- a *Isochilina* sp.
- s *Krausella* sp.
- s *Leperditella* sp.
- a *Leperditia* sp.
- r *Primitia* ? sp.
- c *Schmidtella* sp.

Rockland (Napanee) limestone. A maximum of 10 feet of thin-bedded, very fossiliferous, medium gray (N5) limestone, carrying a Rockland (Napanee) fauna, directly overlies the Chaumont limestone. Its undoubted existence at Wells was first reported by Kay (1937, p. 256). The lower contact cannot be seen owing to glacial sedimentary cover. Thin beds of alternating coarse-textured limestone (calcarenite) and fine-textured limestone (calcilutite) characterize the unit.

The calcarenites abound in the brachiopods *Sowerbyella* and *Resserella* while the calcilutites are typified by large numbers of the brachiopod *Triplesia cuspidata* (Hall). It would appear that the selectivity of *Sowerbyella* and *Resserella* for clearer, quieter water and that of *Triplesia* for more muddy and perhaps agitated water accounts for the stratal distribution. The Napanee environment represents a transitory one between the vigorous, more argillaceous, Selby-Chaumont condition and the quiet clear Kirkfield environment. The finding of the trilobite *Bathyurus spiniger* in both the Chaumont and Napanee limestones suggests either contemporaneity or the lack of any appreciable Black River-Trenton hiatus; such a hiatus has been postulated by some workers.

The sole limestone mentioned by Kemp, Newland and Hill (1898, pp. 148-150) is the "Trenton" and the portion of it that they have reference to corresponds to the Rockland (Napanee) of modern usage. They failed to recognize any strata of Black River age.

Exposure of the Rockland (Napanee) limestone is spotty and not altogether satisfactory for adequate description. The best outcrop lies 0.9 mile north of where N. Y. Route 30 crosses the Sacandaga River at the northern edge of the village of Wells. The following is a representative suite from the Napanee limestone at Wells.

Bryozoa:
- c Species not determined

Brachiopoda:
- s *Dinorthis pectinella* (Conrad)
- s *Parastrophina hemiplicata* (Hall)
- a *Resserella rogata* (Sardeson)
- a *Sowerbyella curdsvillensis* Foerste
- c *Strophomena* sp.
- c *Triplesia cuspidata* Clark

Gastropoda:
- s *Bucania punctifrons* Emmons
- s *Liospira* sp.
- s *Lophospira perangulata* Hall
- r *Phragmolites compressus* (Hall)

Cephalopoda:
- r *Michelinoceras* sp.

Trilobita:
- s *Bathyurus spiniger* Hall
- r *Bumastus trentonensis* (Emmons)
- r *Calliops callicephalus* (Green)
- r *Ceraurus pleurexanthemus* Green
- s *Isotelus gigas* DeKay

Conularida:
- r *Conularia* sp.

Echinodermata:
- c Crinoid columnals

Kirkfield limestone. This unit crops out only sporadically within the Wells outlier and, strictly speaking, it is not recognizable as a lithologic entity. Its presence was established on the basis of the trilobite *Encrinurus cybeliformis* Raymond, otherwise it might well have escaped recognition. The fauna is very similar to the underlying Rockland (Napanee), though the variety and abundance of species is not as great. Crinoid columnals form a more prominent part of the fauna.

Outcrops of the Kirkfield limestone fortuitously occur in, or on the fringe of, the kame topography. On the geologic map (figure 2), the Kirkfield is marked by the Mohawkian limestone-Canajoharie shale contact. The full thickness is not shown but it cannot be in excess of 10 feet. Judging by the concealed interval between the Chaumont limestone and the Utica-Canajoharie shale along the unnamed brook near the southern limit of the limestone belt, and providing that 10 feet are allotted to the Rockland (Napanee) limestone, the Kirkfield thickness is reduced to 5 feet at most.

Medium to thin-bedded subcoquinites and calcarenites typify this unit, though it is difficult to place a natural boundary between the Kirkfield and subjacent Rockland. There appears to be a gradation upward into coarser-textured limestone with a complimentary diminution upward in the finer textured material. For mapping purposes, no practical formational contact can be drawn. The color of the coarse-textured limestone is consistently a medium (N5) to medium dark gray (N4) and weathers uniformly to a medium light gray (N6). Grains of quartz, garnet and less commonly feldspar and hornblende are relatively more abundant than in the other Mohawkian limestones. This closing phase of carbonate deposition undoubtedly took place in shallow agitated water in which a greater supply of clastics were being deposited with the lime.

No evidence was obtained to indicate the presence of the Shoreham

limestone, which occupies the stratigraphic position between the Kirkfield and Utica-Canajoharie units in the Mohawk and Champlain Valleys. Judging by the thickness of the concealed interval and the occurrence of the trilobite *Cryptolithus tesselatus* Green (zone fossil of the Shoreham) in the lower Utica-Canajoharie black shale at Wells, the Shoreham limestone is absent or, at most, exceedingly thin.

Utica-Canajoharie shale. As the Utica and Canajoharie shales are not separately mappable on lithologic grounds and as the continuous black mud phase of deposition constitutes a single mappable unit (formation) in the Mohawk Valley, it seems preferable to use provisionally the hyphenated term, Utica-Canajoharie, until a final nomenclatorial decision is reached.

Numerous small exposures of calcareous black shale occur between the limestone belt and the ridge bounding the valley on the west. Stratigraphic position and faunal content disclose this unit to be correlative with the lower portion of the black shale phase of sedimentation in the Mohawk Valley which was previously assigned to the Minaville member of the Canajoharie formation (Kay, 1937, p. 268). The black shale within the Wells outlier has yielded the following, many of which are beautifully pyritized.

Brachiopoda:
- s *Craniops trentonensis* (Hall)
- s *Leptobolus insignis* Hall
- s *Lingula* sp.
- c *Rafinesquina* sp.
- c *Resserella rogata* (Sardeson)
- s *Trematis terminalis* (Emmons)

Pelecypoda:
- r *Cyrtodonta* sp.

Trilobita:
- r *Cryptolithus tesselatus* (Green)
- c *Orimops* (*"Flexicalymene"*) senaria (Hall)

Graptozoa:
- s *Corynoides calicularis* Nicholson
- c *Diplograptus amplexicaulis* (Conrad)

The presence of *Diplograptus amplexicaulis* and the apparent absence of *Triarthrus becki* Green, the zone fossil of the upper or Fairfield member of the Canajoharie shale, verifies the age assignment of this unit.

Owing to the presence of a syncline paralleling the Elbow-Three Ponds Mountain fault, together with variable dip due to drag, it is

difficult to determine the thickness of this unit at Wells. In all probability, at least 150 feet of shale occur although previous estimates have been as high as 250 feet. The basal beds are never exposed but the lowest visible strata, probably no more than 10 feet from the base, are blocky calcareous argillites carrying essentially the same fauna as the younger thinner shale beds. The best exposure of the Utica-Canajoharie shale is along the unnamed stream 1 mile south-southwest of Mount Rouge and 0.8 mile west of the center of the village of Wells.

Pyrite-rich black shales denote an environment deficient in oxygen-rich water and one not conducive to habitation by most marine organisms. Deeper quieter water than normal is suggested.

PALEOGEOGRAPHY

The Wells outlier is noteworthy for its contribution to paleogeography, the study of the distribution of ancient lands and seas. Of primary interest is the fact that the existence of Lower Paleozoic sedimentary rocks within the confines of the Adirondack Mountains demonstrates that this portion of the Adirondacks was not always an exposed land mass. In fact, it is unlikely that there was very much, if any, of the Precambrian Adirondacks exposed until mid-Mohawkian time. Ruedemann (1898) has shown, by the preferred orientation of graptolites, that the current direction, during the deposition of the Utica-Canajoharie black mud, was such that there could not have been any large land mass to the north of the Mohawk Valley. Furthermore, the clasticity of the Mohawkian strata does not increase appreciably northward from the Mohawk Valley nor westward from the Champlain Valley. The failure to find more clastic facies in the isolated outliers of the Adirondack Mountains suggests that the sediments were contiguous across the Adirondacks or else that the Adirondack land mass was of such low relief that only a slight amount of eroded material was being supplied to the adjacent seas.

It is significant that no strata of Canadian age or Chazyan age have been identified in any of the numerous outliers. It is highly probable, though admittedly speculative, that Canadian seas inundated the Adirondacks and that the deposits were subsequently removed during the epi-Canadian and pre-Chazyan interval. This would necessitate uplift of the Adirondacks concurrently with the close of the Canadian, sufficient to prevent submergence by Chazyan seas. During Chazyan time, the Adirondacks were worn down to the point where Lowville sediments could be deposited far into the Adirondack interior. The lack of large amounts of clastic material in these initial Lowville deposits is testimony to the low relief of the Adirondacks. Chaumont deposits

represent a more typical marine environment dominated by nautiloid cephalopods. The similarity of Chaumont faunas in the Black River Valley at Wells, and in the Champlain Valley attests to the submergence of the Adirondacks during this portion of geologic time.

Trentonian time must have witnessed some differential uplift so as to create isolated environments, for early Trentonian (Rockland) deposits show little or no similarity in the Black River, Mohawk and Champlain Valleys. The subsequent Kirkfield fauna and lithology are fairly uniform in these regions so that the early Trentonian barriers must have been relatively temporary features. An alternate explanation is that Rockland environments were less extensive and more diversified, whereas the Kirkfield environment was areally larger and more uniform in makeup.

An influx of clastics from the east beginning in Shoreham time and continuing throughout the remainder of the Ordovician period produced a condition in which differing, though synchronous, environments occurred on either side of the Adirondack Mountains. It is interesting to note that, though the Shoreham limestone (zone of *Cryptolithus tesselatus*) is present as far north as Watertown in the Black River Valley and as far north as Crown Point in the Champlain Valley, it is absent at Wells which is further south than these localities. It is possible, though not demonstrable owing to concealment, that the Utica-Canajoharie shale is disconformable upon the Kirkfield at Wells. In the central Mohawk Valley the Utica-Canajoharie shale is separated from the underlying Trentonian limestone at Canajoharie by a disconformity and at Sprakers, 3 miles to the east, the Utica-Canajoharie is disconformable upon Lower Ordovician (Canadian) dolomite.

ECONOMIC ASPECTS

While engaged in field investigation in the Wells region, several inquiries were made of the writer pertaining to possible economic exploitation of the geologic resources. This section is appended in response to these and future requests.

Economic usefulness of bedrock and surficial deposits within the Wells outlier is limited. Local needs may adequately be supplied but larger operations for exporting are definitely not feasible.

The low conical glacial hills (kames) which lie between Algonquin Lake and the high ridge west of the lake are capable of furnishing moderate amounts of sand and gravel for local consumption. These symmetrical hills, deposited by retreating glaciers, consist of a heterogeneous mixture of pebbles, cobbles and boulders of many kinds of rock in a matrix of sand and clay—the clay is subordinate. Such ma-

terial may be useful for concrete aggregate or fill, while the sieved gravel can be utilized for road bedding.

Some of the bedrock within the Wells outlier could be exploited for crushed rock or agricultural lime if need be, though the quantity of rock available is small and the quality, for the most part, unsuitable. The Lowville limestone is potentially the best prospect. It is an exceedingly pure limestone (less than 5 percent insoluble residue after digestion with hot hydrochloric acid), noncherty and relatively free from quartz sand. It is massive, free from shale intercalations, and the system of jointing offers no serious problem to quarrying. Overburden is slight with thin mantle and sparse forest cover. Drainage presents no difficulty, providing workings do not extend lower than lake level. The most logical quarry site is along the unnamed stream at the southern extremity of the limestone belt (figure 2) where an approximate working face of 20 feet may be developed. However, only the lower half of this working face comprises the Lowville limestone. The steep northwesterly dip is objectionable as horizontal workings will cause penetration of progressively more of the less desirable overlying Chaumont limestone. The volume of high grade rock is therefore limited. It is estimated that a maximum of 360,000 cubic feet of Lowville limestone may advantageously be obtained along the southernmost portion of the limestone belt. The Lowville limestone could be used for agricultural lime (absence of sulfur), crushed rock for road ballast or, because of its compactness, small quantities of dimension stone could be procured.

The Chaumont limestone is usable for crushed rock, though it offers the serious disadvantage of possessing considerable amounts of black chert nodules which cause excessive wear on crushers. Similarly, the Little Falls dolomite is even less desirable because of its higher chert content, although the larger volume of rock which is available 150 yards east of New York Route 30 in the village of Wells may offset the cost of frequently replacing crushers.

The Rockland (Napanee) and Kirkfield limestones are undesirable and definitely not recommended for agricultural lime or dimension stone owing to their thin-beddedness and frequent shale intercalations. In addition, they possess a higher impurity content; quartz sand being the primary objectionable impurity. Relatively thick overburden usually conceals the bedrock. In addition, the small potential working face (15 feet) renders profitable quarrying improbable. Exploitation of these units for crushed rock is therefore not advocated.

In the past, the Utica-Canajoharie black shale has been used for fill in very small quantities. Future limited use along such lines may be employed though the problem of thick overburden is usually present.

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Plate Ia. Lowville limestone along unnamed stream at southern edge of limestone belt. Hammer rests on thin pebble layer within the formation. Strata dip 17° north-northwest.

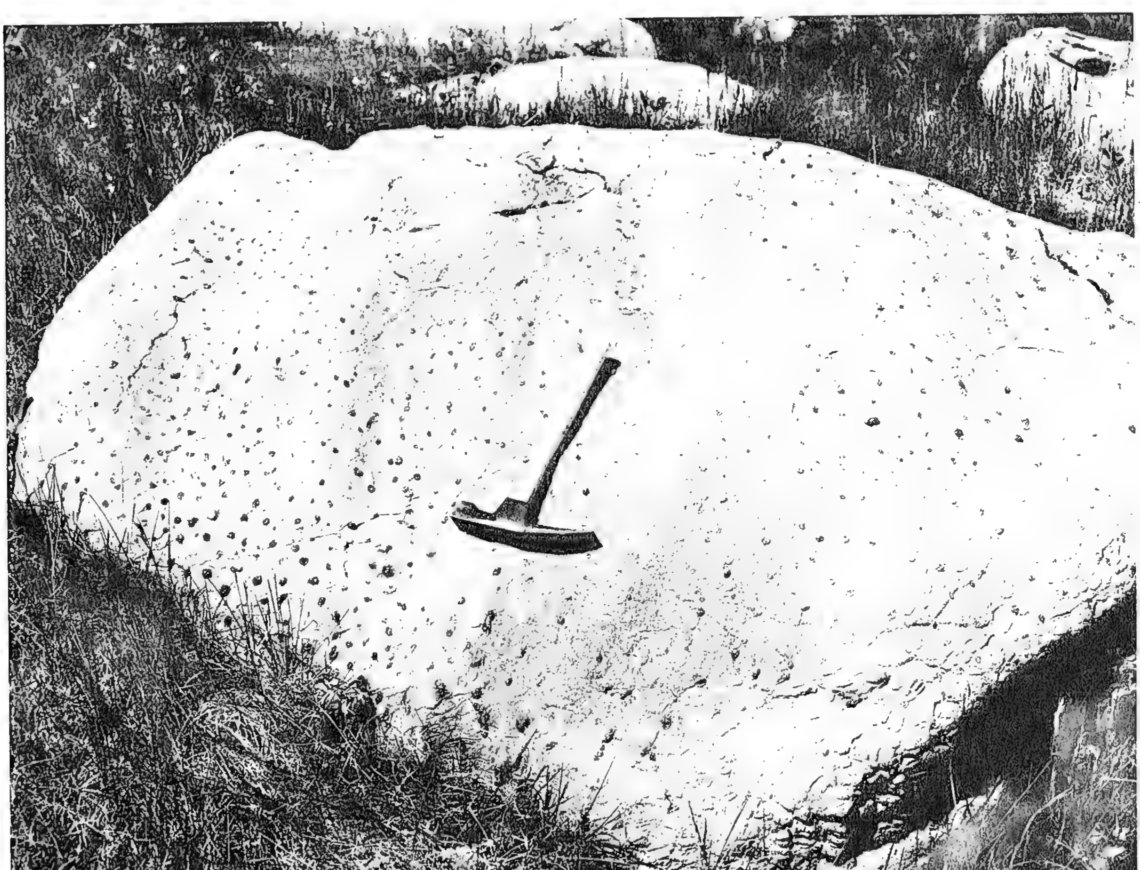

Plate Ib. Bedding plane exposure of "Dove-gray" lithofacies of Lowville limestone illustrating the profusion of fillings of the worm boring, *Phytopsis tubulosus* Conrad.

Plate II

Chaumont Fossils from Wells, N. Y.

Figure 1. *Lambeophyllum profundum* (Conrad), (x2), silicified calyx. N.Y.S.M. 10727.

Figure 2. *Pachydictya* sp., (x2), silicified zoarium. N.Y.S.M. 10728.

Figure 3. *Hesperorhtis tricenaria* (Conrad), (x2), silicified pedicle valve. N.Y.S.M. 10729.

Figure 4. *Doleroides ottawanus* Wilson, (x1). N.Y.S.M. 10730.

Figure 5. *Rafinesquina* sp., (x1), pedicle valve. N.Y.S.M. 10731.

Figure 6. *Liospira lenticularis* (Emmons), (x1), side view. N.Y.S.M. 10732.

Figure 7. Apical view of same specimen showing gradually expanding whorls.

Figure 8. *Helicotoma planulata* (Salter), (x2), showing whorls strongly shouldered with a well-marked carina at shoulder angle. N.Y.S.M. 10733.

Figure 9. *Cyrtodiscus* sp., (x1), side view of bellerophontid gastropod. N.Y.S.M. 10734.

Figure 10. *Lophospira* cf. *perangulata* (Hall), (x2), side view of silicified specimen. N.Y.S.M. 10735.

Figure 11. *Holopea symmetrica* Hall, (x2), note circum-umbilical costae and transverse growth lines. N.Y.S.M. 10736.

Figure 12. *Clionychia lamellosa* (Hall), (x1), lamellose growth lines are prominent. N.Y.S.M. 10737.

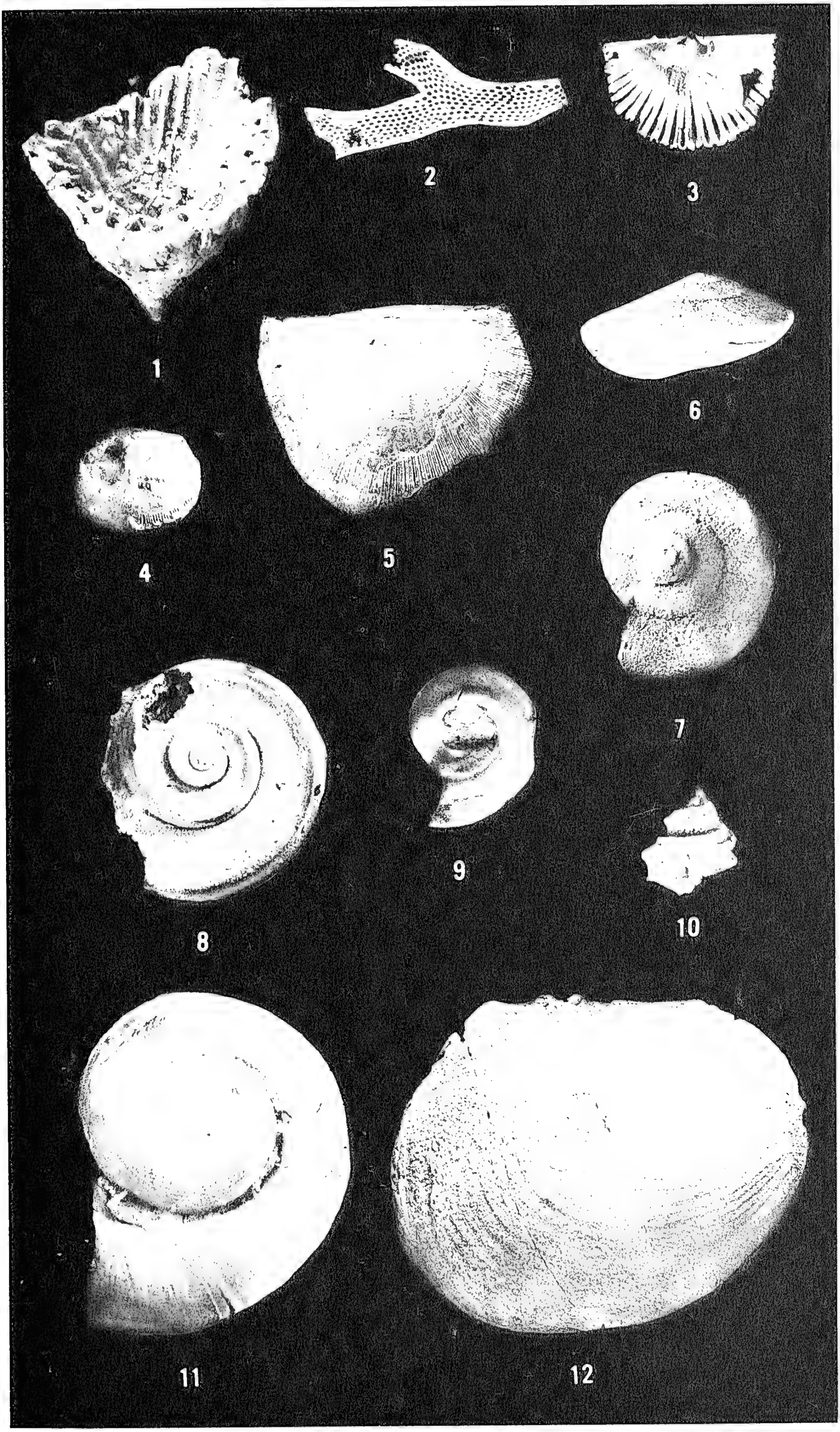
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Plate III

Chaumont Fossils from Wells, N. Y.

Figure 1. *Plectoceras undatus* (Conrad), (x1). N.Y.S.M. 10738.

Figure 2. *Sactoceras* sp., (x1), silicified specimen showing the globular siphuncular segments. N.Y.S.M. 10739.

Figure 3. *Oncoceras collinsi* Foerste, (x2), short conch enlarges rapidly. N.Y.S.M. 10740.

Figure 4. *Spyroceras* sp., (x1), note distant pronounced annulations. N.Y.S.M. 10741.

Panorama taken from the summit of West Hill looking north along the valley formed by the Wells graben. Precambrian ridges flank the graben on the left (west) and right (east) while Algonquin Lake, visible in the center of the picture, occupies the floor of the Paleozoic Valley.

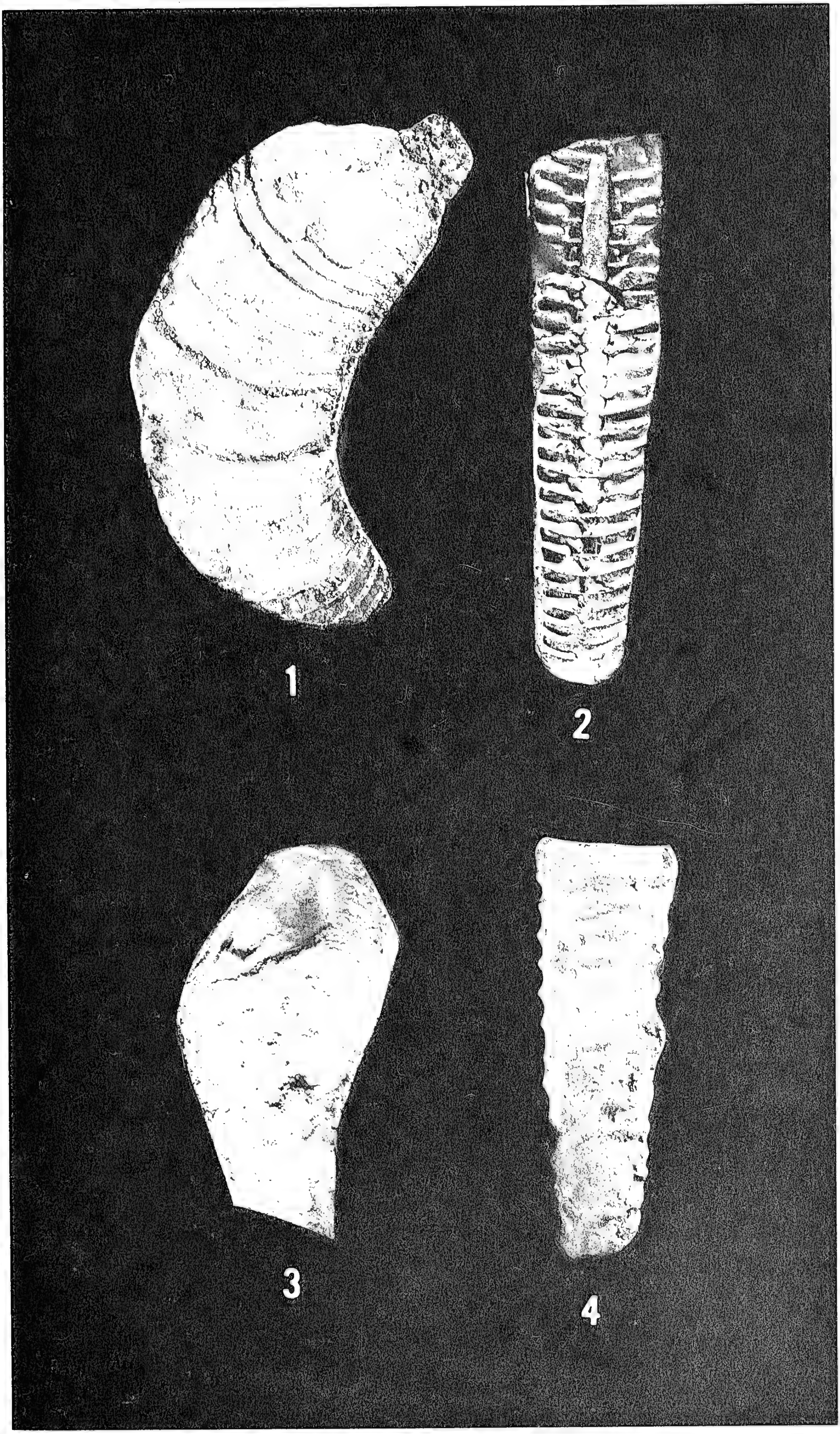
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Plate IV

Chaumont Fossils from Wells, N. Y.

Figure 1. *Michelinoceras* sp., (x1), note relatively large chambers. N.Y.S.M. 10742.

Figure 2. *Actinoceras tenuifilum* Hall, (x1), weathered specimen showing the large siphuncle and nummuloidal siphuncular segments. N.Y.S.M. 10743.

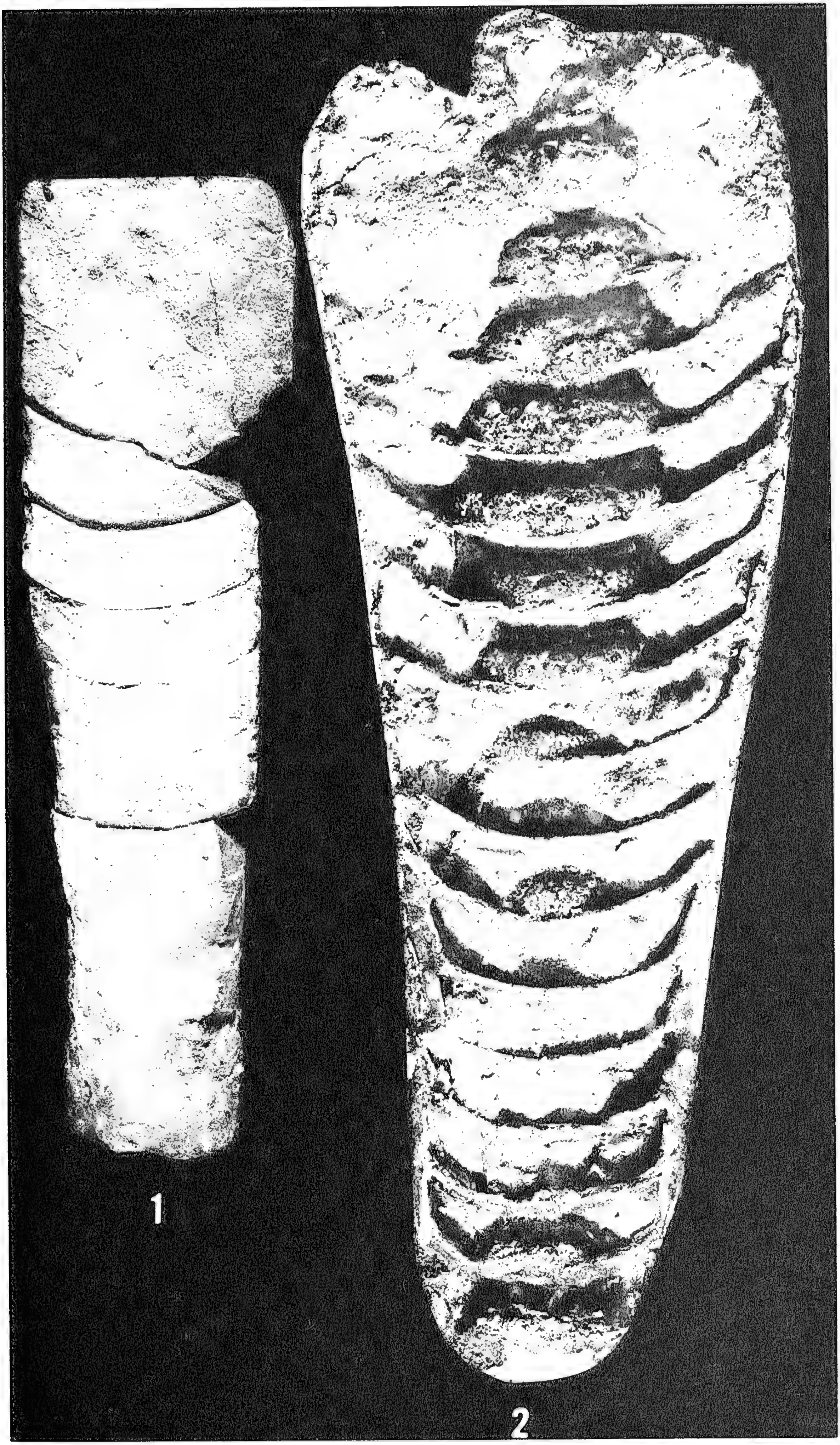
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Plate V

Chaumont Fossils from Wells, N. Y.

Figure 1. *Gonioceras anceps* Hall, (x1), silicified specimen etched with dilute hydrochloric acid to show the siphuncle and septa to advantage. Within the lenticular conch, the septa arch strongly downward along the central part but arch strongly upward in the "wing" part of the conch. The siphuncular segments are relatively small. N.Y.S.M. 10477.

Figure 2. *Actinoceras tenuifilum* Hall, (x1), silicified specimen etched with dilute hydrochloric acid to better disclose the character of the siphuncle and septa. N.Y.S.M. 10745.

Figure 3. *Bathyurus extans* (?) (Hall), (x1), cranidium showing the pitted surface. N.Y.S.M. 10746.

Figure 4. *Bathyurus spiniger* Hall, (x1), cranidium. N.Y.S.M. 10747.

Figure 5. Pygidium of same species, (x1). N.Y.S.M. 10748

Figure 6. *Illaenus* cf. *conradi* Billings, (x1), well-preserved cephalon. N.Y.S.M. 10749.

Figure 7. Portion of slab profuse with ostracodes, *Leperditia* being most abundant. N.Y.S.M. 10750.

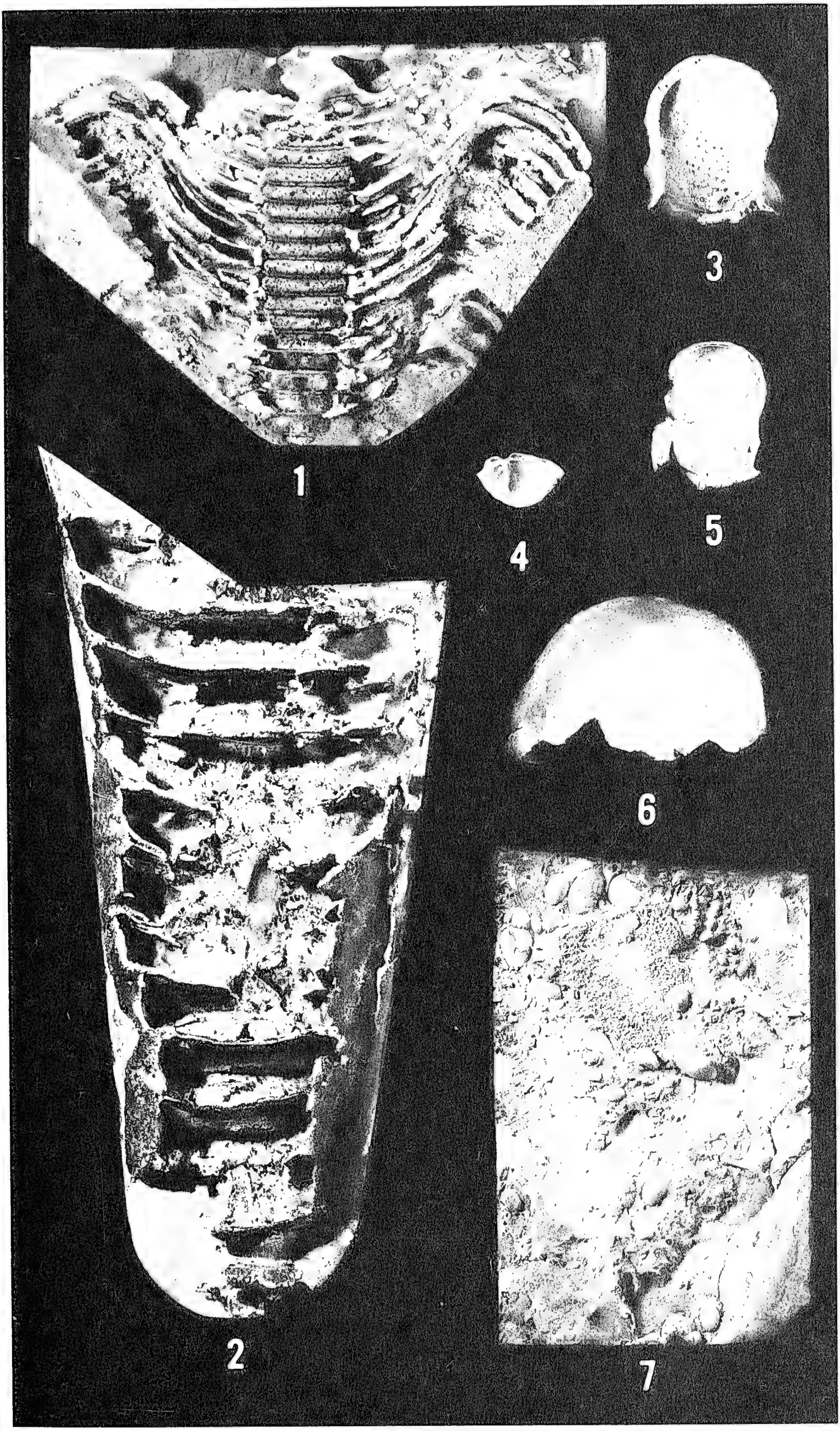
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Plate VI

Post-Chaumont Mohawkian Fossils from Wells, N. Y.

Figure 1. Ventral view of *Triplesia cuspidata* Clark, (x1), Rockland (Napanee) limestone. N.Y.S.M. 10751.

Figure 2. Anterior view of the same specimen. Note pronounced sulcus.

Figure 3. Brachial valve of a mature specimen of *Resserella rogata* (Sardeson), (x1). Note strong development of radiating costellae. Rockland (Napanee) limestone. N.Y.S.M. 10752.

Figure 4. Pedicle valve of immature specimen of same species, (x1), Rockland (Napanee) limestone. N.Y.S.M. 10753.

Figure 5. Portion of slab showing *Sowerbyella curdsvillensis* Foerste, (x1), Rockland (Napanee) limestone. N.Y.S.M. 10754.

Figure 6. Side view of the bellerophontid *Bucania punctifrons* Hall, (x1), Rockland (Napanee) limestone. N.Y.S.M. 10755.

Figure 7. Peripheral view of same specimen showing carina, (x1).

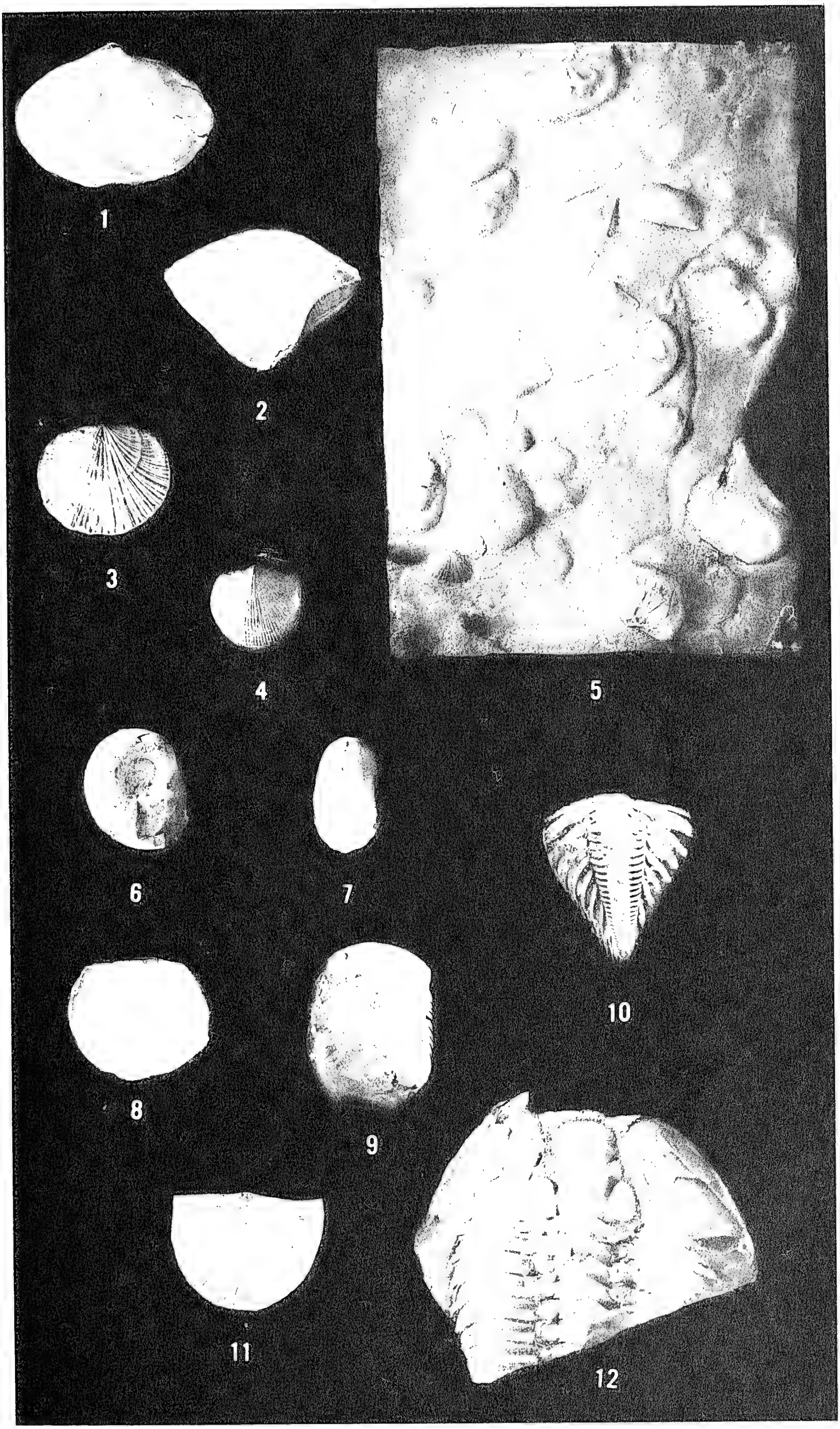
Figure 8. *Trematis terminalis* (Emmons), (x2), Kirkfield limestone. N.Y.S.M. 10756.

Figure 9. *Bumastus trentonensis* (Emmons), (x1), a nearly complete specimen from the Rockland (Napanee) limestone. N.Y.S.M. 10757.

Figure 10. Pygidium of *Encrinurus cybeliformis* Raymond (x2) from the Kirkfield limestone. N.Y.S.M. 10758.

Figure 11. Pyritized specimen of *Rafinesquina* sp. (x1) from the Utica-Canajoharie black shale. N.Y.S.M. 10759.

Figure 12. Incomplete pyritized specimen of *Orimops* (*"Flexicalymene"*) *senaria* (Hall) (x2) from the Utica-Canajoharie black shale. N.Y.S.M. 10760.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Flora of the Columbia County Area, New York

BY
ROGERS McVAUGH
Temporary Botanist

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CONTENTS

ERRATA

p. 24, paragraph 2: Delete sentence beginning "Specific epithets in the Flora. . ."

p. 70, line 3 from bottom: For *Ultricularia* read *Utricularia*.

p. 103, line 3 under **H. psycodes**: For *Corallorrhiza* read *Corallorhiza*.

p. 129, lines 7 and 11: for *variegata* read *variegatum*.

p. 223: Delete both lines of couplet numbered 11, in key to Aster, and add:

11. Leaves strongly auriculate- or cordate-clasping, *11a*

11a. Plants scabrous-puberulent, slender and wiry; leaves entire, with rough-ciliate margins *A. patens*

11a. Plants pilose or hirsute (occasionally glabrous), coarse; leaves usually dentate or serrate. *A. puniceus*

11. Leaves half-clasping *A. junciformis*

p. 311, line 8: For *nudiculis,* read *nudicaulis.*

p. 352, right-hand column, line 2: For *gracilis,* read *maculata.*

ILLUSTRATIONS

All figures are from photographs and line drawings by the author.

Figure 44. No Bottom Pond, Austerlitz. Limestone ledges may be seen along the shore at the right side of the picture.

Figure 45. Flat Brook, looking north from near Edwards Park Station. The grass in the foreground is *Phalaris arundinacea;* the common shrub along the brook is *Myrica Gale.*

Figure 46. Larch swamp at Miller Pond, Ancram

Figures 47, 48, 49. Mature forest about 1 mile northeast of Stuyvesant. Note the density of the stand and the presence of standing dead trees. Young plants of sugar maple appear in the foreground of figures 47 and 48.

Figure 50. View across the valley of Bashbish Brook, looking north-northeast from Washburn Mountain. The hill in the foreground is covered principally by thickets of *Quercus ilicifolia.*

Figure 51. Mount Alander, looking east from a point about 3 km. south of Copake

Figure 52. The village of Copake Falls as seen from Washburn Mountain; the village is about 200 meters below the point from which the picture was taken. Note the lichens growing on the otherwise bare rocks in the right foreground.

Figure 53. Vegetation near the summit of Washburn Mountain. Lichens nearly cover the rocks at the left, and at the right are mats of bearberry, *Arctostaphylos Uva-ursi.*

Figure 54. Shale knoll about 1.5 km. south of Germantown. The shale here is harder than at some other points in our area and relatively little weathering is noted.

Figure 55. Shale slopes along the Hudson River north of Poelsburg. The shales here disintegrate easily and the slopes are unstable and covered by small fragments of weathered rock.

Figure 56. Sand flats just north of Nutten Hook. The vegetation consists primarily of two annual grasses, *Eragrostis pectinacea* and *Triplasis purpurea.* The black hummocks in the background are plants of *Cycloloma.*

Figure 57. Sand flats north of Nutten Hook. The sand in the foreground is covered by *Triplasis purpurea;* the young trees in the background are poplars (*Populus deltoides*). The picture was taken October 6, 1935, when the trees were 2 to 5 meters in height.

Figure 58. Silvernail Falls, in Roeliff Jansen Kill. Falls of this sort are frequent in the larger creeks of our area.

Figure 59. Rocky gorge in the shales about 1 km. south of Poelsburg. The stream follows a winding course which may be followed nearly to the top of the hill by the small patches of white water.

Figure 60. Lower end of the gorge shown in figure 59. The slopes on both sides are formed of small fragments of the rotten shales. A few hemlocks find a foothold in this precarious position.

Figure 61. The mouth of Bashbish Gorge, looking northeast from the summit of Washburn Mountain. The mountain at the right is Bashbish Mountain and that across the gorge is Cedar Mountain.

Figure 62. Bashbish Gorge as seen from just north of Copake Falls. The mountains rise abruptly from the lowlands of the Harlem Valley.

Figure 63. View down Bashbish Gorge, looking west from a point directly above the falls. The hills in the distance are on the west side of the Harlem Valley.

Figure 64. Map of Columbia County showing the distribution of *Pellaea atropurpurea,* which is confined to outcrops of limestone rock. The distribution of this and a small group of other species is almost exactly that of the limestone outcrops.

Figure 65. Map of Columbia County showing the distribution of *Sarracenia purpurea,* a species characteristic of bogs.

Figure 66. Map of Columbia County showing the distribution of *Parnassia glauca.* This species is unknown in the area except in the calcareous marshes of the Harlem Valley and in a similar habitat in the town of Kinderhook.

FLORA OF THE COLUMBIA COUNTY AREA
NEW YORK

BY

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INTRODUCTION

Since the middle of the 18th century the State of New York has been a favorite area for the exploration of field botanists. In the early days its conspicuous natural features, such as the Catskill Mountains, the Finger Lakes and Niagara Falls, attracted many visitors, some of whom studied the vegetation and commented upon it. In later years the spread of civilization in New York was rapid and numbers of local botanical studies were made. At the present time it may seem rash to state that any considerable section of New York is virtually unknown botanically, but such proved to be the case. The great valley of the Hudson River Estuary, east to the Massachusetts and Connecticut State lines, and, to a lesser extent, west to the mountain fronts in Albany, Greene and Ulster Counties, has never been thoroughly explored by students of the vegetation.

A moment's consideration will suffice to show this clearly. The Catskill and Adirondack Mountain Ranges, as well as the Shawangunks in southeastern New York, have been the subjects of both sporadic and continued studies by many botanists (see House, 1916); Long Island and the metropolitan area, including the lower Hudson Valley, have occupied the interests of able men at the New York Botanical Garden for a number of years (see Taylor, 1915; "Flora of the Vicinity of New York," including a list of local floras for the area covered); west of the eastern mountains of the State there is available a flora of the upper Susquehanna (Clute, 1898); there is a recent study of the Tug Hill Plateau (Hotchkiss, 1932). Professor Wiegand and his associates have greatly increased our knowledge of the flora of central New York (see Wiegand & Eames, 1926). In western New York studies have been made on the nonglaciated territory in Cattaraugus County (House & Alexander, 1927), and Zenkert's (1934) "Niagara Frontier" flora sums up well the present state of knowledge in that area. For the upper part of the Hudson River Estuary, however, there is a lack of recent comprehensive work dealing with the plant life of the region.

The reason for such a condition is in part a geographical one. Attention has been centered about New York City, near Albany and in the more conspicuously mountainous districts. The Hudson Valley, which is an intensively cultivated region containing relatively little rough country, at least above the Hudson Highlands, has been passed by as uninteresting and presumably of little importance in phytogeography. Although many botanists and other students of natural history have passed through this part of New York State from time to time, the published accounts of their visits or of conditions pre-

vailing there have been sketchy and unsatisfactory. The purpose of the present study is to give a full account of the vegetation of a part of the Hudson Valley, including its history, its relationships to the vegetation of neighboring areas and its significance to persons living in the area.

LOCATION OF REGION

The part of the Hudson Valley to be discussed here is a roughly rectangular area bounded on the west by the Hudson River and on the east by the summits of the Taconic Mountains. It includes all of Columbia County, N. Y., and smaller adjoining portions of Rensselaer and Dutchess Counties, N. Y., and Berkshire County, Mass.

The area of the present study, as originally intended, was to include Columbia County only. Unfortunately, as is so often the case, political boundaries were found to be almost wholly unrelated to geographic ones. In order to establish better natural limits it was thought advisable to include some additional territory in the drainage basins of the principal streams of the county. As at present delimited, the area is bounded on the west by the Hudson River and on the north by the boundaries of the watershed of the Muitzes Kill and that of Kinderhook Creek. On the east it extends to the limits of the watersheds of Kinderhook Creek and Roeliff Jansen Kill and includes also the small part of Columbia County which lies in the Housatonic drainage. On the south it extends to the limits of the watershed of Roeliff Jansen Kill and includes also parts of Dutchess and Columbia Counties which are drained by Stony Creek (figure 1).

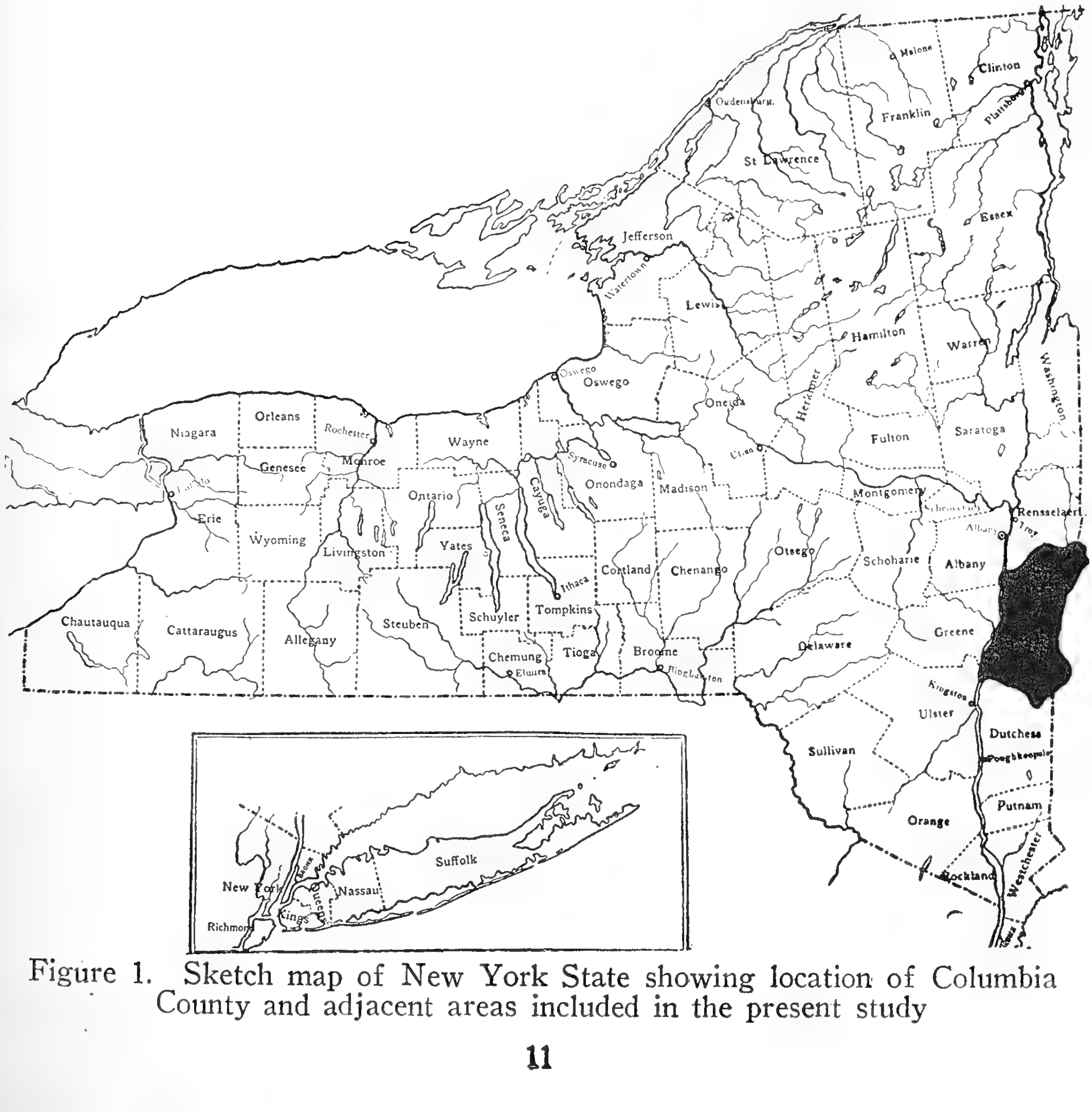

Figure 1. Sketch map of New York State showing location of Columbia County and adjacent areas included in the present study

Topographically speaking, the region which is to be discussed lies in a great valley, that of the Hudson Estuary. The elevation above sea level increases gradually eastward, reaching an average limit of somewhat less than 2,000 feet (600 meters) along the eastern boundary. The highest point is the summit of Mount Everett, in the town of Mount Washington, Berkshire County, where the elevation is 2,624 feet. The hills along the eastern boundary of our area represent the southern and western foothills of the Taconic Mountain Ranges which extend northward through western Massachusetts and into Vermont; these mountains occupy most of western Massachusetts (the "Berkshires") but quickly flatten out south and west of that state.

The Columbia County section of the Hudson Valley is thus seen to be part of the southern lobe of a topographic lowland which extends from the western slopes of the Taconics west to the rather sharply defined escarpments of the Catskills and the Helderbergs. The southern boundary of this lowland is formed by the Hudson Highlands, the most northern extension of which is Stissing Mountain, an outlying granitic mass in Pine Plains. Northward the area extends to the southern edge of the Rensselaer Plateau, which is floristically the southernmost outlier of the northern highlands.

INDEX TO LOCALITIES IN THE COLUMBIA COUNTY AREA

Most of the localities cited in the following pages are to be found on the topographic maps published by the United States Geological Survey. Some localities, however, bear well-established local names but are not listed upon these or other maps. These obscure localities may be found by reference to the index which follows.

Those wishing to locate or cite any locality mentioned in the systematic part of this Flora will note that frequent reference has been made to the several "towns" comprising the Columbia County area. The counties of Columbia, Rensselaer, Dutchess and Berkshire are divided into political units called "towns," which are equivalent in general to the "townships," "boroughs" or "hundreds" in other parts of the United States. Thus when reference is made to "Perry Peak, Canaan," the town of Canaan is understood to be meant, not the village of the same name. A locality written as "2 miles east of Austerlitz," on the other hand, refers to the village of Austerlitz, not the town.

The towns in Columbia County adjacent to Massachusetts are, from north to south, New Lebanon, Canaan, Austerlitz, Hillsdale, Copake and Ancram. These are occasionally referred to as the "eastern tier of towns." Occupying a central position in the county from north to south are the towns of Chatham, Ghent, Claverack, Taghkanic and Gallatin. The town of Kinderhook lies west of Chatham and north of Ghent. Bordering the Hudson River, from north to south, are the towns of Stuyvesant, Stockport, Greenport, Livingston, Germantown and Clermont. The city of Hudson lies on the river, surrounded by the town of Greenport.

The part of Rensselaer County treated here includes nearly all of the towns of Nassau and Stephentown, the southern and eastern edges of Schodack, the southeastern corner of Sand Lake (as far north as Little Bowman Pond), and the southwestern quarter of Berlin. This comprises the northern part of the drainage basin of Kinderhook Creek and (in Schodack) the basin of the Muitzes Kill. The northernmost extension of the Kinderhook Basin is near a point west of Center Berlin, about 12 miles north of the Columbia County line; farther east the same stream drains most of the southern half of the town of Hancock, Mass.

With the exception of Hancock, as noted above, the only major area in Berkshire County which is treated below is the town of Mount Washington, most of which drains into the Hudson by way of Bashbish Brook. A few ponds in the extreme northwestern corner

of Connecticut (Litchfield County, town of Salisbury) are included because of their floristic relations with the rest of our area, but are situated on the summit of a divide and are almost without any drainage.

In Dutchess County the area drained by Roeliff Jansen Kill includes part of Northeast, the eastern half of Pine Plains, a few square miles of Stanford, and the northeast quarter of Milan. Stony Creek drains the north end of the town of Red Hook.

The gazetteer includes relatively few settlements, except the very smallest ones, as these are readily found in atlases and on road maps. An attempt has been made to include such settlements, however, when names currently used differ from those on the topographic sheets, published by the U. S. Geological Survey, which have been used as the standards of reference.

Following the name of each locality the name of the town is given in parentheses, and after this is a statement of the actual position of the locality within the town or towns in question. Lastly a reference is given to a map sheet on which the name appears, or on which the locality appears under another name, or on which appears a symbol indicating the locality (as for unnamed lakes or for schools). References to the map sheets are given by numbers in *italic* type, corresponding to the numbers assigned to the maps in the following list. Thus the entry "Judson Point *(8)*" indicates that this locality is found on the map of the Coxsackie Quadrangle.

1. Albany Quadrangle (N. Y.), 1/62500. 1927
2. Ancram Quadrangle (N. Y.), 1/24000. 1948
3. Berlin Sheet (N. Y.-Mass.-Vt.), 1/62500. Jan. 1898
4. Canaan Quadrangle (N. Y.-Mass.), 1/31680. 1947
5. Catskill Quadrangle (N. Y.), 1/62500. 1938
6. Claverack Quadrangle (N. Y.), 1/31680. 1947
7. Copake Quadrangle (N. Y.-Mass.), 1/62500. Sept. 1904
8. Coxsackie Quadrangle (N. Y.), 1/62500. 1929
9. Kinderhook Quadrangle (N. Y.), 1/62500. 1933
10. Millbrook Quadrangle (N. Y.-Conn.), 1/62500. May 1902
11. Pine Plains Quadrangle (N. Y.), 1/24000. 1948
12. Pittsfield Sheet (Mass.-N. Y.), 1/62500. Oct. 1897
13. Sheffield Sheet (Mass.-Conn.-N. Y.), 1/62500. Oct. 1897
14. Stephentown Center Quadrangle (N. Y.), 1/31680. 1947
15. Troy Quadrangle (N. Y.), 1/62500. 1928

Alvord's Dock (Stockport). At the point mapped *(8)* as Judson Point, 1 mile north of the mouth of Stockport Creek. Not mapped.

Ancramdale (Ancram). Appears on Copake Quadrangle *(7)* as Ancram Lead-mines and on earlier maps as Hot Ground.

Arnolds' Mill (Ghent). 1.5 miles northeast of Ghent, on the Kline Kill. *(9)*

Ashley Hill (northeast corner of Chatham). 1.5 miles northeast of Riders Mills. *(9)*

Bachus Pond (Chatham). 1 mile north of Malden Bridge. *(9)*

Bashbish Gorge (Copake, Mount Washington). Bashbish Brook rises in Massachusetts and cuts through the mountain front to the Harlem Valley at Copake Falls. Bashbish Falls is in Massachusetts. *(13)*

Becraft Mountain (Greenport). South of Hudson. Mapped *(5)* as Becraft Hills.

Bells' Pond (northeast corner of Livingston). Mapped *(5)* as Bell Pond, but never so called.

Berry Pond (Hancock). About 2 miles east of the corner where New Lebanon, Stephentown and Hancock adjoin, at an elevation of about 2,000 feet (600 m.). Drains into Wyomanock Creek and so into Kinderhook Creek. *(3)*

Bingham Pond (Salisbury). On the divide, about 2.5 miles southeast of the corner where Massachusetts, Connecticut and New York adjoin. *(13)*

Blue Hill (Livingston). North end of town. *(5)*

Brace Mountain (northeast corner of Northeast). Elevation about 2,300 feet (690 m.). *(13)*

Brainard (southeast corner of Nassau). *(9)*

Canaan (Canaan). Also mapped *(12)* as Canaan Four Corners. *(4)*

Canticoke Swamp (Nassau). 3 miles east-northeast of Nassau. *(15)*

Cedar Mountain (Copake). Elevation about 1,800 feet (540 m.). The mountain to the north of the gorge of Bashbish Brook, 1.5 to 2 miles east of Copake Falls. *(13)*

Copake Ironworks (Copake). Now Copake Falls. *(7)*

Croghan Hill (Ancram). A limestone knob 3 miles north and somewhat east of Ancramdale. Known to Hoysradt and so called by him. Mapped *(7)* as Old Croken. Extensive calcareous marshes lie both east and west of it.

Crugers' Island (Red Hook). A rocky "island" in the Hudson River south of Tivoli, connected to the mainland by a causeway between the North and South "Bays." Mapped as Cruger Island. *(5)*

Curtis Mountain (Nassau). A north-south ridge 1 mile west of Tackawasick Lake and about 3 miles east-northeast of Nassau. *(15)*

Douglas Knob (New Lebanon, Canaan). A ridge about 800 feet high, 4 miles long, parallel to the mountain fronts and separated from them by a narrow valley. Mapped *(4)* as The Knob.

Fingar Marsh (Gallatin). A sphagnum bog known to Hoysradt and so called by him. About 1 mile a little west of south of a small pond (Pond Lily Pond, *2)* which is in turn 1 mile southeast of Taghkanic Lake. The bog is not mapped; it lies at the head of the most easterly branch of the Fall Kill *(2)*. The roads leading near the bog are now (1934) impassable except on foot.

Forest Lake (southeast corner of Claverack). Mapped as Forest Pond. *(6, 7)*

Fowlers' Lake (Ghent). About 3.5 miles south-southeast of Kinderhook, and about the same distance a little south of east from Stuyvesant Falls. Not mapped.

Fox Hill (Ancram). 1 mile southwest of Boston Corners. *(7)*

Guilder Pond (Mount Washington). About ½ mile northwest of Mount Everett, on the Hudson-Housatonic Divide. *(13)*

Harvey Mountain (Austerlitz). Elevation 2,065 feet (620 m.). About 2.5 miles east of Austerlitz, nearly on the state line. *(12)*

Hemlock School (Kinderhook). About 3 miles south-southeast of Kinderhook, near the southern edge of the town. *(9)*

Hoags' Corners (Nassau). 6 miles northeast of Nassau. *(15)*

Hot Ground (Ancram). An early name for Ancramdale (q. v.); used by Hoysradt (1875-79).

Jackson Corners (Milan). About 3 miles southeast of Elizaville. *(2, 7)*

Knickerbocker Lake (Kinderhook). About 2 miles west of the north end of Kinderhook Lake. *(9)*

Lee Pond (Mount Washington). A little southeast of the center of the town; one of the sources of Bashbish Brook. *(13)*

Livingston Creek. See Roeliff Jansen Kill.

Long Pond (Ancram). 3 miles southwest of Copake. Mapped under this name. *(7)*

Long Pond (Berlin). In the southwestern quarter of the town; one of the sources of the Black River and of Kinderhook Creek. *(3)*

Magdalen Island (Red Hook). A small rocky island in the Hudson River, south of Tivoli. *(5)*

Merwins' Lake (Kinderhook). 2 miles south and a little east of Kinderhook. (9, unnamed)

Mill Creek (Stuyvesant). Empties into the Hudson River about 2 miles north of Stuyvesant. *(8)*

Miller Pond (Copake, Ancram). On the town line, about 2.5 miles southwest of Copake. *(7)*

Miller Pond (Pine Plains). About 3.5 miles southwest of Pine Plains, on the southwestern slopes of Stissing Mountain. *(11)*

Mount Alander (Copake, Mount Washington). Elevation 2,243 feet (673 m.). The summit is in Massachusetts, but most of the collections have been made in New York. Mapped as Alander Mountain. *(7)*

Mount Everett (Mount Washington). Elevation 2,624 feet (787 m.), the highest point on the divide east of the Columbia County area. *(13)*

Mount Fray (northeast corner of Copake). Elevation about 1,900 feet (570 m). *(13)*

Mount Merino (Greenport). Near the Hudson River, southwest of the city of Hudson. *(5)*

Mount Riga [station] (Northeast). On the Harlem division of the New York Central Railroad, 4 miles south of Boston Corners. *(10)*

Mount Riga (Salisbury). Elevation about 2,000 feet (600 m.). One mile east of the New York line and 2.5 miles south of the Massachusetts line. *(13)*

Mud Pond (Gallatin). 3 miles east of Elizaville and about the same distance north of Jackson Corners. (*7*, unnamed).

Muitzes Kill (Schodack). A village 2 miles east of Schodack Landing and 1 mile north of the Columbia County line; pronounced "mitches kill." The stream of the same name rises in the hills along the line between Stuyvesant and Kinderhook, flows north about 5 miles, then northwest and west, emptying in the Hudson about 1 mile south of Castleton. *(1, 9, 15)*

No Bottom Pond (Austerlitz, northeastern part). *(12)*

Omi (Ghent). 1 mile northeast of West Ghent. *(9)*

Perry Peak (Canaan). Elevation 2,070 feet (620 m.). The summit is in Massachusetts, about 4 miles south of Lebanon Springs; several collections have been made on the western slopes in the town of Canaan. *(4, 12)*

Pikes' Pond (Nassau). In the northern part of the town, 2.5 miles north of Hoags' Corners. *(15)*

Pinnacle [rocks] (Taghkanic). Rough broken summits about 3 miles southeast of Churchtown. Mapped as Pinnacle. *(6)*

Plantain Pond (Mount Washington). Southeastern corner of the Town; drains into the Housatonic. *(13)*

Poelsburg (Stuyvesant). On the Hudson River 2 miles south of the Rensselaer County line. Mapped *(8)* as Poolsburg.

Post Road School (Kinderhook). On U. S. Highway 9, about 4.5 miles north of Kinderhook and 1 mile south of the Rensselaer County line. *(9)*

Pulvers Corners (Pine Plains). 4 miles east of Pine Plains. *(10)*

Pulvers [station] (Ghent). A station on the Harlem division of the New York Central Railroad, about 3.5 miles south-southwest of Ghent. *(9)* Mapped as Pulvers.

Riga Lake (Salisbury). About 2 miles south of the corner where Massachusetts, Connecticut and New York adjoin. *(13)*

Risedorph Hill (Pine Plains). Near the village of Pine Plains; a locality often cited by Hoysradt and visited by House and McVaugh (see Amer. Fern Jour. 23: 122-124. 1933). Not mapped.

Robinson Pond (Copake). About 2 miles west of Copake Falls. Mapped *(7)* under this name but currently (1935) called Browns' Pond.

Roeliff Jansen Kill (Dutchess and Columbia Counties). Rises in the hills between Hillsdale and Austerlitz; receives water of Bashbish Brook and drainage from the mountains as far south as Boston Corners and Pulvers Corners (Punch Brook). Receives Shekomeko Creek near Silvernails. Mapped as Livingston Creek on soil map. *(2, 5, 7)*

Round Pond (Berlin). In the southwestern quarter of the town; one of the sources of Black River and of Kinderhook Creek. *(3)*

Shaver Pond (Copake). About ½ mile east of Robinson Pond (q. v.). *(7)*

Shekomeko Creek. Rises in Stanford, Northeast and Pine Plains; flows generally northwest into Roeliff Jansen Kill near Silvernails. *(10)*

Spring Lake (Red Hook, Milan). On the line between Red Hook and Milan, 1.5 miles south of the Columbia County line. Not in the Columbia County area. *(5)*

Stissing Mountain (Pine Plains). The northernmost outlier of the Hudson Highlands, lying about 2 miles west of Pine Plains, its long axis nearly north and south. The northern, and lower, summit is called Little Stissing. Stissing Mountain is a famous locality because of collections made there by Hoysradt and Peck, but except for the northwestern slopes the entire mountain lies outside the Columbia County area as formally defined. *(11)*

Stockport Creek (Stockport). Formed by the junction of Kinderhook and Claverack Creeks, near Stockport and about 2 miles from the Hudson River; flows southwesterly into the river. *(8)*

Stockport Station (Stockport). A station on the New York Central Railroad, at the Hudson River on the north side of Stockport Creek. *(8)*

Stony Creek (Red Hook, Clermont, Germantown). Empties into the Hudson River south of Tivoli (the "North Bay"). *(5)*

Sutherland Pond (Chatham). Between East Chatham and Chatham Center. *(9)*

Tackawasick Lake (Nassau). 4.5 miles east-northeast of Nassau. *(15)*

Taghkanic Lake (Gallatin). Mapped *(7)* as Charlotte Lake (called locally Lake Shalótt). *(2)*

Taplins' Pond (Stephentown). About 3 miles east of north of West Lebanon, and 5 miles east of the Massachusetts-New York line *(3;* also on *14,* as Taplin Pond).

Thompson Pond (Pine Plains). Southwest of Pine Plains, in the valley east of Stissing Mountain. The southernmost of three ponds (Mud, Stissing and Thompson) which drain southward into Wappinger Creek. *(11)*

Tom Hill (Copake). A limestone knob about 1.5 miles southwest of Copake Falls. *(7)*

Turedy Lake. Not located. So named on labels distributed with specimens collected by A. T. Beals and party, May 30, 1926. The specimens are deposited in the local herbarium of the New York Botanical Garden. The lake was said to be in or near Austerlitz, but Mr. Beals informed me in a letter, about 1932, that this was probably an error, and that he had no memory or records of having visited any lake by this name. Beals' party is known to have been somewhere east of the village of Chatham, and it seems probable that the name "Turedy Lake" is a corruption of the name of the largest body of water in this general area, Queechy Lake.

Waldorf Pond (Kinderhook-Chatham). Immediately north of Kinderhook Lake; the stream flowing through the pond forms the boundary between Kinderhook and Chatham. Name derived currently from the owners, Waldorf Farms. (*9*, unnamed)

Washburn Mountain (Copake). Elevation 1,548 feet (464 m.); 1 to 1.5 miles south of Copake Falls. *(7)*

White Mills Pond (Chatham). West of the village of Chatham and mostly in the town of Chatham but extending into Ghent. Mapped as Smith Pond on earlier maps, but unnamed later. *(9)*

PART 1: SYSTEMATIC ACCOUNT OF THE SPECIES

In the following pages is presented an account of the vascular plants known to occur outside of cultivation in the Columbia County area. This includes native species, weeds and escapes from cultivation found growing within the limits of the area. In a few cases mention is made of stations or localities outside the region of the present study, where such mention has some bearing on plant distribution as related to the region itself.

The various species concerned have been admitted to the record as members of the flora either on the basis of my own field study or after study of herbarium specimens collected by others or, in a relatively few cases, on the basis of published but unverified records. The latter have in all cases been cited in the text for what they are. In the case of reports of critical or poorly understood species, special attempts have been made to state plainly the exact situation in regard to their occurrences in the area.

The arrangement of families and genera in the present study is essentially the same as that of House (1924). Certain changes have been made in this order, the most notable being the following:

The Pteridophyta have been arranged according to the order proposed by Eames (1936). The arrangement of the Gramineae follows that of Hitchcock (1935); the treatment of the genus *Carex* is based on that of Mackenzie (1931-35) and the treatment of the Scrophulariaceae follows that of Pennell (1935).

The use of "common" or English names for plants has been given a somewhat restricted application in the following pages. While every plant known to science has been given a name derived from Latin or Greek according to the so-called binomial system of nomenclature, relatively few plants, and those only among the more conspicuous or well-known ones, have English names which are in actual use. Many attempts have been made to supply common names for the poorly known and inconspicuous species, but with little success. Fennel-leaved pondweed, and Curtiss's triple-awned grass, for example, both of which appear in at least one widely used current floristic work, are names known to no one except their nameless inventor, and are not common names at all. Such plants as *Potamogeton pectinatus* and *Aristida Curtissii,* to which the English names mentioned above have been applied in books, often have no common names; they are known to the layman as "weeds" or "grass." On the other hand, a plant like *Symplocarpus foetidus* is skunk cabbage to every man, be he country or city bred, who has ever smelled it. Skunk cabbage is a

true "common" name, in everyday use, and as such belongs to the plant. An attempt has been made in the present study to restrict the use of English names to those plants for which such names are in actual use, or for which there are well-established and popular book names.

As has been repeatedly pointed out, some confusion may arise through improper use of common names. "Reindeer moss" is not a moss at all, but a lichen; "Spanish moss" is not even remotely related to moss, but is a close cousin of the pineapple; "Club moss" is not a moss but a fern ally. Such common names are of doubtful value as approaches to systematic botany, for they obscure the relationships of the plants in question and may actually be misleading. Following the practice of Zenkert (1934), I have attempted to place all misleading or misapplied common names between quotation marks by way of cautioning the reader against drawing false inferences. *Juncus Gerardi,* for example, a common plant of the salt marshes of the Atlantic coast, is known ordinarily as "Black grass," although it is not a grass but a member of the rush family. Many similar cases are to be found in the text.

Analytical keys to the genera and species of plants included in the systematic list have been added to make identification of unknown plants easier for the reader. These keys have been adapted freely from those found in standard floristic works, with additions and subtractions as necessary for the Columbia County flora. Descriptions of the families, genera and species have been omitted, as in a work of limited scope such as this one they tend to produce volume without adding an equal amount of value. Completely adequate descriptions of all the plants concerned may be found in *Gray's Manual* or other standard floristic works. Persons interested in the geographical ranges of the various species will find them elucidated in the same works.

After the name of each species included in the present account will be found a brief statement of its range, habitat and frequency in the Columbia County area. The statements of range are thought to be self-explanatory, although the user of the book may wish to consult the text (p. 237) where the limits of the Hudson and Harlem Valleys are defined. The terms used to describe the various sorts of plant habitats are thought to be nearly self-explanatory as well, with the possible exception of "bog," "swamp" and "marsh," all of which are wet-soil habitats. As used in this account, a swamp is understood to be a place where the soil is permanently wet and where the vegetation consists in part of trees or tall bushes. A marsh

is equally wet, but the vegetation is characterized by the presence of grasses or grasslike plants and by the comparative scarcity of trees. A bog has as its principal feature the presence of large amounts of organic material in the soil; the soil, in fact, may be almost wholly made up of such organic remains, and be referred to as peat.

The terms used to describe abundance and frequency are similar to those used by Zenkert (1934) for a similar study, and used subsequently by McVaugh (1938) in connection with a survey of the aquatic vegetation of Chautauqua Lake. The term abundance refers to average density of population per unit area, while frequency refers to distribution in space. A plant may be infrequent in a given range, meaning that it occurs at relatively few localities; it may at the same time be abundant wherever found. The following general terms are used in describing frequency and abundance:

Frequency	*Abundance*
Common	Abundant
Frequent	Sparse
Infrequent	
Rare	

A common plant is reasonably expected to be found in all or nearly all suitable habitats throughout, while a plant designated as frequent probably occurs in not more than 50-75 percent of the suitable habitats in the same area. A species said to be infrequent occurs in a relatively small percentage of the possible spots; the upper limit may be arbitrarily set at 25 percent of the suitable habitats. The species designated as rare have been found a few times only; the term is practically self-explanatory.

When a species is said to be abundant, it is understood that the individual plants in a given locality are relatively crowded or close together, sometimes forming a pure or nearly pure stand; the term sparse, on the other hand, means that the individual plants are more widely separated.

The various descriptions of habitat and frequency are based largely upon field studies and are compiled from notes as well as from memory. In the absence of detailed statistical studies, however, the statements of abundance and frequency become very largely expressions of individual opinion and should be regarded as such.

Common and widely distributed species are included without citation of specimens, with few exceptions. In the case of rare species or those with restricted ranges, however, it has been thought desirable to cite representative collections or records from literature.

Where the locality alone is cited, it indicates that I have seen the plant in question at this locality or have seen a specimen from there. My own collections are cited by number only, no collector's name being indicated. Citation of collector by name and number of collection, or of collector and date, without any accompanying abbreviation for herbarium, indicates that the specimen is deposited in the herbarium of the New York State Museum at Albany. Where necessary to prevent ambiguity, this is abbreviated (NYS). Other herbaria are indicated by the following symbols, which, as far as possible, are those proposed by Lanjouw (1939):

BKL—Brooklyn Botanic Garden, Brooklyn.
CU—Cornell University, Ithaca.
GA—University of Georgia, Athens, Ga.
GH—Gray Herbarium, Harvard University, Cambridge, Mass.
MICH—University of Michigan, Ann Arbor, Mich.
MO—Missouri Botanical Garden, St. Louis, Mo.
NEBC—New England Botanical Club, Gray Herbarium, Harvard University.
NY—New York Botanical Garden, New York
PENN—University of Pennsylvania, Philadelphia, Pa.
PH—Academy of Natural Sciences, Philadelphia, Pa.
TRT—Toronto University, Toronto, Ontario, Canada.
US—United States National Herbarium, Washington, D. C.
USNA—United States National Arboretum, Washington, D. C.
V—Vassar College, Poughkeepsie.

Throughout the present volume the metric system is used in recording measurements wherever practicable. As nearly all published data, however, are given in inches, feet, miles and acres, it has not seemed necessary or advisable to transpose them for use here. Nearly all herbarium specimens collected in this country are located as having been taken a certain number of miles from some definite place. When an attempt is made to convert these figures to meters or kilometers, awkward and misleading fractions may result, so that data here reported are taken directly from the specimens. Throughout the systematic account, elevations above sea level are given in meters. By those who prefer to use the English system, the following conversion table may be used:

1 meter	= 39.37 inches	= 3 feet, 3.37 inches
1 kilometer	= 1,000 meters	= approximately 5/8 mile
1 hectare	= 2.47 acres	

Throughout the preparation of this account of the flora and vegetation of the Columbia County area I have benefited by the advice

and criticism of Dr. H. D. House, the State Botanist of New York from 1914 to 1948.[1]

It is a pleasure to express to Dr. House my appreciation of this association which has now extended over more than 15 years. Many thanks are also due to all the other botanical friends who have extended the courtesies of their several institutions and performed personal favors of various kinds.

My active field work in the Columbia County area was brought to a close in 1936, but since that time Dr. House has made a number of excursions into the area, particularly into that part of it which lies in Rensselaer County, near the northern limits of the watershed of Kinderhook Creek. In 1949 he very kindly sent me a long list of his own recent collections, and other collections which I had not been able to examine at the time of the preparation of this manuscript in 1941 and 1942. It has not been possible to check his determinations of all these specimens but the more interesting ones have been cited below in the systematic account when there seemed to be no reasonable doubt of the identifications. All such specimens, reported by Dr. House but not verified, are cited in square brackets.

The nomenclature employed in the present study is that of the *International Code of Botanical Nomenclature* (1952). When the manuscript for the Flora was completed for publication in 1941 and 1942, the scientific names of plants were in large part those found in the seventh edition of *Gray's Manual* (Robinson & Fernald, 1908). Minor revisions in the manuscript were made in 1949, to bring taxonomy and nomenclature somewhat into accord with then current opinion, and to make certain necessary additions, chiefly those which had been brought to my attention by Dr. House. It should be noted that descriptive passages and notes on the occurrence of individual species pertain to a period not later than 1940, when my field work in the Columbia County area came to an end.

At the time of the last revision of the manuscript, in December 1949, announcement had just been made of the forthcoming publication of the long-awaited eighth edition of *Gray's Manual,* under the authorship of Professor M. L. Fernald. Before the publication of *Gray's Manual,* however, funds for the printing of the Columbia County Flora became available and the manuscript was set up in type. The galley proof was read and corrected but, because of an unfortunate series of events, actual publication was never effected. In the autumn of 1955 plans for publication were again initiated, and it was thought best to attempt a further revision, in order to

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[1]Dr. House died Dec. 21, 1949.

bring the nomenclature of the Flora into some degree of conformity with that used in the new *Gray's Manual*. Because of other work to which I was committed, I was unable to devote the necessary time and thought to the revision at this particular time, and Mr. Stanley J. Smith of the New York State Museum kindly volunteered to undertake the onerous task of making the necessary changes. He completed the work in December 1955, and I should like to express here my gratitude for his interest and painstaking thoroughness.

In certain cases the names used in this Flora for plant-species differ from the ones used in the eighth edition of *Gray's Manual*, and in such cases appropriate reference is made to the *Manual*. The differences have arisen in some cases because of varying taxonomic interpretations, because of recent studies which were not available to Professor Fernald in 1950, or in a few cases because of the seeming impossibility of reconciling the nomenclatural opinions expressed by Fernald with those held by Mr. Smith and myself. Differences of opinion as to the limits of plant-genera and plant-families have resulted in some discrepancies at this level also, but no cross-references have been inserted except for the names of species. Specific epithets in the Flora have been spelled consistently with a small initial letter, in conformity with the present recommendation of the International Code.

The taxonomic opinions expressed in the Flora, naturally enough, are chiefly those which I held about the year 1940. In the intervening period my ideas and concepts have doubtless been altered in many ways, but because it has not been possible to attempt a conscientious reevaluation of the whole flora, it has seemed advisable to reduce innovations to a minimum. In certain cases, therefore, especially those involving taxonomic opinion, the names used for species are those of *Gray's Manual*, and are those which in 1940 I should have accepted as taxonomically correct, but which I should now question in the light of altered concepts of species and subspecific taxa.

The State Botanist's Office has furnished much assistance with the preparation of the final manuscript. This involved much difficult revision of the old galley proofs, and I am especially grateful to Dr. E. C. Ogden for the many hours he spent on this and for his part in urging the ultimate publication of the Flora.

Division I. PTERIDOPHYTA

LYCOPODIACEAE ("Club-moss Family")

Lycopodium L.

1. Sporangia in the axils of ordinary leaves, not forming a well-marked terminal spike *L. lucidulum*

1. Sporangia in the axils of the upper leaves, which are modified and bractlike, the whole forming a dense terminal spike, *2*

2. Bracts of the spike similar to the foliage leaves in form and texture *L. inundatum*

2. Bracts of the spike very different from the leaves of the sterile parts of the stem, *3*

3. Sterile branches convex and uniformly leafy on all sides, *4*

4. Fertile branches leafy up to the usually solitary spikes; leaves not bristle-tipped, *5*

5. Creeping stem deep in the ground, the upright branches treelike, repeatedly forked *L. obscurum*

5. Creeping stem on or near the surface, its numerous erect branches sparingly or not at all branched *L. annotinum*

4. Spikes 2 to 4 on a slender scaly peduncle; leaves bristle-tipped *L. clavatum*

3. Sterile branches flattened or concave beneath, the leaves usually reduced or modified on the lower surface, *6*

6. Fertile branches leafy up to the spikes *L. obscurum*

6. Spikes borne on a slender scaly peduncle, *7*

7. Creeping stems at or near the surface of the ground; branchlets strongly dorsiventral, the leaves on the lower surface much smaller than the lateral ones; plants yellowish green *L. complanatum*

7. Creeping stems rather deeply buried; leaves on the lower side of the branchlets scarcely smaller than the others; plants bluish green *L. tristachyum*

L. lucidulum Michx. Prince's feather. Moist, usually cool woods; frequent. Rare or local in the Hudson Valley, but very abundant eastward.

L. inundatum L. "Columbia County" according to an unverified report by House (1924); Stephentown, *House 22830.*

L. obscurum L. "Ground pine." Dry or moist woods; common. Abundant eastward; locally so in the Hudson Valley. South of Niverville, *245;* Waldorf Pond, *House 20913;* 3 miles south of Kinderhook, near Hemlock School, *1428.* Much of our material may be referred to var. **dendroideum** (Michx.) D. C. Eat.

L. annotinum L. "Stiff club moss." Known only from rather moist, shady woods in the towns of New Lebanon and Canaan at elevations of 300 meters or more. 1 mile northwest of Lebanon Springs, *2395, 3670;* Perry Peak, Canaan, *House 21192;* Mount Lebanon, *House 16144.* Represented in our area only by the var. **acrifolium** Fern.

L. clavatum L. Dry woods and banks; apparently rare in the Hudson Valley, but increasingly common eastward. 4 miles north of Lebanon Springs, *2410;* Spencertown, *Whitney 843;* New Forge, *270;* 1.5 miles south of Ancramdale, *3390;* south of Niverville, *243* (PENN). Plants collected at Lebanon Springs by A. K. Harrison have been referred to forma **sterile** House, and may represent a sterile phase of var. **megastachyon** Fern. and Bissell (Rhodora 12: 53. 1910).

L. complanatum L. "Ground pine." Crowfoot. Dry woods or open fields; frequent. Very abundant eastward, but only locally so in the Hudson Valley; forming large patches in fields and thickets, especially in acid soil. Represented in our area only by var. **flabelliforme** Fern.

L. tristachyum Pursh. Dry sandy soils in the northeastern part of the county, at elevations of 300 m. or more; local. 4 miles north of Lebanon Springs, *2412;* 2 miles east of Austerlitz, *292, 2155.*

SELAGINELLACEAE (Selaginella Family)

Selaginella Beauv.

1. Leaves of two sizes, the lateral ones larger and spreading, the inner (upper) ones shorter and appressed to the stem; plants diffuse or prostrate, creeping *S. apoda*

1. Leaves all alike, overlapping each other closely in about 8 rows, uniformly disposed on all sides of the stem; plants usually in little tufts *S. rupestris*

S. rupestris (L.) Spring. Rocks or loose stony soil; frequent. Especially common on the loose shales near the Hudson River, where it grows in small patches, usually in association with *Cyperus filiculmis* and *Polygonum tenue.* Curtis Mountain; 2 miles southeast of Churchtown; Pulvers, town of Ghent; 2 miles east of Elizaville; Stuyvesant Falls (PENN); Ghent, on red shale, *Wherry* (PH); Blue Hill; 1 mile south of Germantown; 1 mile southwest of Clermont.

S. apoda (L.) Spring. Moist places, in neutral or calcareous soil; infrequent. Riders Mills, *4065;* Robinson Pond, *3956;* Pulvers Corners, *3865;* 1.5 miles southeast of Clermont, *3241.*

ISOETACEAE (Quillwort Family)

Isoetes L.[1] Quillwort.

1. Megaspores covered with tiny sharp spines *I. echinospora*

1. Megaspores covered with irregular raised ridges or projections, not spiny, *2*

  2. Ridges of the megaspore forming a sharply defined delicate honeycomb-like network *I. Engelmanni*

  2. Ridges of the megaspore irregularly branching and projecting in crests or teeth *I. riparia*

I. echinospora Dur. (*I. muricata* of *Gray's Manual*) Rocky or muddy margins of lakes, in shallow water; frequent. Represented in our area mostly by var. **Braunii** Engelm. Taghkanic Lake, *2015;* Forest Lake, *2069;* Copake Lake, *3429;* Miller Pond, Stissing Mountain, *3873.* One collection, *Muenscher & Clausen 4128,* from Tackawasick Lake, in the Cornell University herbarium, has been identified by Wiegand as **I. echinospora** var. **muricata** (Dur.) Engelm.

I. riparia Engelm. Mud flats in tidewater along the Hudson River, where quite abundant. An estuarine species first reported from our area by Svenson (Torreya 35: 118. 1935). 2 miles north of Castleton, *3971;* Poelsburg, *3814;* Magdalen Island and Crugers' Island, *2687* (GH), *2943* (GH). Also at No Bottom Pond, *1323, 1963.* Material from No Bottom Pond was determined by Dr. Norma E. Pfeiffer.

[1] The genus *Isoetes* is a difficult one, even for the professional botanist, as the characters appear to intergrade somewhat and the ones used are so minute that a compound microscope is necessary for identification of the various species.

I. Engelmanni A. Br. Shallow water in muddy bottoms of lakes and quiet streams; infrequent. Kinderhook Lake, *House 15542, Muenscher & Clausen 4133* (CU); New Forge, in Taghkanic Creek, *3489;* Nassau Lake, *Muenscher & Clausen 4132.*

EQUISETACEAE (Horsetail Family)

Equisetum L.

1. Stems perennial, stiff and harsh, reedlike, 3 to 7 mm. in diameter, unbranched except when injured, or irregularly branched at base; teeth of the nodal sheaths soon deciduous *E. hyemale*

1. Stems annual, usually not at all stiff or harsh, at least the sterile ones with regular whorls of branches at the nodes; teeth of the nodal sheaths persistent, *2*

  2. Sheaths on the main stem 15- to 20-toothed, appressed; plants ordinarily not bushy; branches relatively few, usually near the middle of the plant, strongly ascending *E. fluviatile*

  2. Sheaths on the main stem usually not more than 10-toothed, somewhat spreading; plants, at least the sterile shoots, somewhat bushy; branches numerous, *3*

    3. Teeth of the sheaths on the main stem black, firm; fertile stems not developing any green branches; branches of the sterile stems ascending, rather straight *E. arvense*

    3. Teeth of the sheaths on the main stem brown, papery; fertile stems developing green branches and resembling the sterile ones; branches of the sterile stems drooping *E. sylvaticum*

E. arvense L. Common or field horsetail. Sterile or sandy soil; common and abundant, especially along roadsides and railroad embankments.

E. sylvaticum L. Wood horsetail. Moist, especially sandy woods; infrequent. Canticoke Swamp, Nassau, *1747* (PENN); New Britain, *3649;* 1 mile south of Canaan Center, *3617;* Niverville, *393* (PENN); 1 mile north of Kinderhook, *407.* Represented in our area only by var. **pauciramosum** Milde.

E. fluviatile L. Swamp horsetail. Open swamps and borders of slow streams; abundant in the tidal flats along the Hudson River; elsewhere local. Poelsburg, *890;* Rogers Island, *2590;* Tivoli, North Bay, *2784;* Pikes' Pond, *House 21955;* 1 mile south of Fowlers' Lake, *1434;* south of Mount Riga Station, *3374.*

E. hyemale L. "Scouring rush." Woodlands, open fields and embankments, in wet or dry soil; frequent and locally abundant. Represented in our area only by var. **affine** (Engelm.) A. A. Eat.

OPHIOGLOSSACEAE (Adder's-tongue Family)

1. Sterile leaf segments entire, ovate to elliptic-oblong; sporangia fused together in a simple spike 1. **Ophioglossum**

1. Sterile leaf segments variously lobed, pinnate, or decompound; sporangia separate, in loose or compact panicles 2. **Botrychium**

1. Ophioglossum L.

O. vulgatum L. Adder's-tongue. "Moist meadows, boggy depressions, and damp thickets" (House, 1924). Reported by Hoysradt (1875-79) from the "south end of Thompson Pond." Otherwise unknown from our area. An inconspicuous species and perhaps overlooked.

2. Botrychium Sw.

1. Plants large, often 30 to 60 cm. high; sterile part of frond thin and membranous, sessile at about the middle of the plant; base of the stalk (covering the bud) open along one side *B. virginianum*

1. Plants smaller, 5 to 25 (rarely 40) cm. high; sterile part of frond often somewhat fleshy; bud completely inclosed by base of stalk, *2*

2. Sterile part of frond on a stalk 2 to 16 cm. in length, *3*

3. Divisions of the blade deeply and finely lacerated or divided *B. dissectum*

3. Divisions of the blade entire to serrulate or even lobed, but not finely lacerated or divided *B. dissectum* forma *obliquum*

2. Sterile part of frond sessile or nearly so, the petiole, if any, less than 1 cm. long, *4*

4. Sterile part of frond ovate or oblong, short-stalked, the lobes oblong-ovate and obtuse *B. matricariaefolium*

4. Sterile part of frond deltoid, sessile, the lobes lanceolate, acute *B. lanceolatum*

B. matricariaefolium A. Br. Grape fern. Moist shady woods; infrequent and sparse. Stuyvesant Falls, *5044* (USNA); Taconic Park, near Copake Falls, *5039* (USNA); 1 mile north of Kinderhook, *658, 670;* 3 miles northwest of Ghent, *1425.*

B. lanceolatum (Gmel.) Rupr., var. **angustisegmentum** Pease & Moore. Moist shady woods; infrequent and sparse. Lebanon Springs, *2407;* Brainard, *House 21538;* Stissing Mountain, *Hoysradt* (PENN); 1 mile north of Kinderhook, *671;* No Bottom Pond, *4525.*

B. dissectum Spreng. Dry fields and woods; infrequent. 1 mile north of Kinderhook, *142* (PENN); Mount Alander, *Hoysradt* (PENN).

Forma **obliquum** (Muhl.) Fern. *(B. obliquum* of *Gray's Manual).* Dry fields and woods; frequent. Intermediates between this form and the last occur, but most plants seen have the appearance of f. *obliquum.* West side of Douglas Knob, New Lebanon, *3630;* Old Chatham, *2443;* northwest of Niverville, *2442;* 1 mile north of Kinderhook, *157* (PENN).

B. virginianum (L.) Sw. Rattlesnake fern. Moist rich woods; common throughout.

OSMUNDACEAE (Royal fern Family)

Osmunda L.

1. Fronds twice pinnate, fertile at the tip *O. regalis*

1. Fronds once pinnate, the pinnae deeply pinnatifid, *2*

2. Fertile and sterile fronds wholly separate *O. cinnamomea*

2. Fertile pinnae median, with sterile ones above and below them *O. Claytoniana*

O. cinnamomea L. Cinnamon fern. Wet places; common. Often very abundant in swampy woods.

O. Claytoniana L. Interrupted fern. Wet places; frequent. Very abundant and a characteristic feature of upland meadows and thickets at higher elevations in the eastern part of the county.

O. regalis L. Royal fern. Wet places; common. Especially abundant in swampy woods. Represented only by var. **spectabilis** (Willd.) Gray.

DICKSONIACEAE (Tree fern Family)

Dennstaedtia Bernh.[1]

D. punctilobula (Michx.) Moore. Hay-scented fern. Woods and swamps; frequent throughout. An abundant pasture weed in poor rocky soils in the eastern part of the county, but much less abundant in the Hudson Valley, where local. Canticoke Swamp; Austerlitz; North Chatham; Canaan Center; Boston Corners; Stuyvesant Falls; Pine Plains, *Hoysradt* (PENN).

POLYPODIACEAE (True fern Family)

1. Fertile fronds, or portions of fronds, conspicuously unlike the sterile, the green leaf tissue of the fertile blades much reduced or entirely wanting, *2*
2. Fertile fronds, or portions of fronds, scarcely or not at all leaflike, *3*
3. Fronds in a row along a creeping rootstock; fertile fronds twice pinnate; veins in a network 1. **Onoclea**
3. Fronds in a thick clump; fertile fronds once pinnate; veins free, not forming a network 2. **Pteretis**
2. Fertile portions of fronds green and leaflike, terminal, the pinnae much narrower than the adjacent sterile ones 5. **Polystichum**
1. Fertile fronds, or portions of fronds, essentially like the sterile in appearance, *4*
4. Sporangia borne at the margins of the lobes or segments of the blades, either in definite sori or as a continuous marginal line, partially covered by a reflexed portion of the edge of the leaf blade, *5*
5. Pinnules without a distinct midvein, the small veins repeatedly forked, all about equal in size 11. **Adiantum**
5. Pinnules (or pinnae in once-compound leaves) with a distinct midvein, the smaller veins pinnately arranged, *6*
6. Leaves produced singly in a row along a slender underground creeping rootstock; blade mostly appearing ternate because of the elongation of the lowest pinnae 12. **Pteridium**
6. Leaves in clusters, from a short rootstock clothed with reddish brown scalelike hairs; blades pinnate; stipe and rachis dark brown 13. **Pellaea**
4. Sporangia usually borne in definite sori distinctly away from the leaf margin, or, if apparently at the margins of the lobes or segments, not covered by a reflexed portion of the edge of the leaf blade, *7*
7. Young sori (and indusia, when present) more or less circular, the sori appearing as roundish dots on the lower side of the leaf, *8*
8. Leaf blades deeply pinnatifid, the lobes entire or essentially so; sori without indusia, prominent; fronds rarely more than 30 cm. in length, arising in a row along a creeping rootstock 14. **Polypodium**
8. Leaf blades pinnately or ternately cleft or pinnate, the segments variously toothed, cleft or divided, *9*
9. Leaf blades once pinnate, the pinnae bristle-toothed or serrate, but without conspicuous lobes except a single triangular one on upper side at base 5. **Polystichum**
9. Leaf blades once or more pinnately or ternately divided, the pinnae always deeply lobed or themselves pinnate, *10*
10. Indusia attached all around and beneath the sori, at first inclosing them but soon splitting into several spreading lobes,

[1] *Dennstaedtia* is regarded by Fernald in the 8th edition of ***Gray's Manual*** as a genus of the *Polypodiaceae;* the family arrangement followed here is that advocated by Eames, *Morphology of Vascular Plants.*

these sometimes narrow and hairlike; fronds in dense clusters, usually intermixed with the persistent straw-colored or darker stipes of previous years; stipes jointed near base; stipe of the present season with conspicuous brownish or light chaffy scales **3. Woodsia**

10. Indusia, if present, apparently attached by center or at the side, the sporangia partially covered by them and projecting from beneath them, *11*

11. Indusium, if present, appearing mushroom-shaped (peltate), with a cleft or indentation at one side, the sporangia projecting nearly equally on all sides from the indusium **6. Dryopteris**

11. Indusium attached by its base at one side of the sorus, partially covering the sorus like a hood but soon withering **4. Cystopteris**

7. Young sori (and indusia when present) elongated, oblong to linear, often curved, *12*

12. Leaf blades simple, entire, narrow, long-tapering and rooting at tips; veins forming a network **8. Camptosorus**

12. Leaf blades variously pinnate or at least deeply lobed; veins mostly free or in a few species forming a few areoles but free most of their length, *13*

13. Sori parallel to the midveins of pinnae or their lobes, often confluent into long lines; veins forming a row of areoles along midvein, but free beyond that **7. Anchistea**

13. Sori more or less parallel to the oblique lateral veins of the pinnae or their lobes, sometimes curving and crossing them, *14*

14. Leaves mostly small, 5 to 30 cm. long, evergreen (if over 30 cm., rachis shining dark brown); sori not strongly curved **9. Asplenium**

14. Leaves mostly large, 35 to 100 cm. long, not evergreen; rachis green or sometimes reddish; sori, at least in part, strongly curved or hooked **10. Athyrium**

1. Onoclea L.

O. sensibilis L. Sensitive fern. Wet places; very common.

2. Pteretis Raf.

P. pensylvanica (Willd.) Fern. Ostrich fern. Alluvial soil along streams; infrequent, but apparently throughout the area. No Bottom Pond, *1332;* Kinderhook Creek, north of Riders Mills, *1262;* 1.5 miles north of Kinderhook, *980;* north of Stuyvesant along Mill Creek, *246;* 1.5 miles southeast of Clermont, *3238;* 2 miles north of Tivoli, *2797* (TRT).

3. Woodsia R. Br.

1. Mature fronds usually 5 to 15 cm. long, thickly clothed beneath with rusty bristlelike chaff; indusium divided into slender hairs *W. ilvensis*

1. Mature fronds usually 20 to 50 cm. long, not rusty-chaffy; indusium divided into a few broad segments *W. obtusa*

W. ilvensis (L.) R. Br. Exposed rocks and bluffs, usually in slightly acid soil; frequent. Curtis Mountain (PENN); Green River; Cedar Mountain (PENN); Boston Corners; Stissing Mountain; Poelsburg (PENN); Stuyvesant Falls; Blue Hill; 1 mile south of Germantown; 1 mile southwest of Clermont.

W. obtusa (Spreng.) Torr. Rocky woods and on cliffs, often in dry soil; frequent. Green River; North Chatham; 3 miles north of Ancramdale; Stissing Mountain (TRT); 2 miles east of Elizaville; Nutten Hook; Mount Merino (PENN); Tivoli.

4. **Cystopteris** Bernh.

1. Fronds lanceolate, long-drawn-out at tip, usually bearing small bulblets on the lower surface — *C. bulbifera*
1. Fronds ovate-oblong, acute, not bulblet-bearing — *C. fragilis*

C. bulbifera (L.) Bernh. Bladder fern. Frequent in moist rich soil in rocky woodlands; abundant on limestone. Rare in the Hudson Valley, and most abundant eastward. New Lebanon, *739;* No Bottom Pond, *1327;* Green River, *1526;* Copake Falls, *Britton et al.* (NY); Fox Hill, Ancram, *3416;* Stissing Mountain, *Hoysradt* (PENN); West base of Brace Mountain, *House 24866;* Old Chatham, *644;* 3 miles south of Kinderhook, *200* (PENN).

C. fragilis (L.) Bernh. Brittle fern. Rocky woods and on rocks, often in crevices; frequent. Green River, *1527;* Pine Plains, *Hoysradt* (PENN); Cheviot, *2820;* Tivoli, *2812* (TRT); our plant is probably var. *Mackayii* Lawson.

5. **Polystichum** Roth

P. acrostichoides (Michx.) Schott. Christmas fern. Woods; common everywhere.

6. **Dryopteris** Adans.

1. Indusium wanting; rootstocks creeping, *2*
  2. Blade subternate, the basal pinnae stalked; rachis of frond not winged — *D. disjuncta*
  2. Rachis more or less winged; basal pinnae sessile or decurrent, *3*
    3. Blade as broad as or broader than long; rachis above the lowest pair of pinnae winged — *D. hexagonoptera*
    3. Blade longer than broad; rachis above the lowest pair of pinnae practically wingless — *D. Phegopteris*
1. Indusium present, *4*
  4. Rootstocks creeping; veins simple or once forked, *5*
    5. Lower pinnae scarcely or not at all smaller than the others, *6*
      6. Veins, at least in part, forked — *D. Thelypteris*
      6. Veins all simple — *D. simulata*
    5. Lower pinnae gradually and conspicuously reduced, the frond tapering both ways from the middle — *D. noveboracensis*
  4. Rootstocks short, suberect; veins, at least the lowest, more than once forked, *7*
    7. Fronds bipinnate or bipinnatifid, the lobes little or not at all spiny-toothed, *8*
      8. Sori near the margin — *D. marginalis*
      8. Sori not regularly near the margin, *9*
        9. Basal scales of stipe dark chestnut-colored; sori mostly 6 to 10 pairs — *D. Goldiana*
        9. Basal scales light brown; sori fewer, *10*
          10. Indusium glandular-puberulent; blades elongate-lanceolate, somewhat narrowed at base — *D. ×Boottii*
          10. Indusium glabrous, *11*
            11. Blades linear-oblanceolate; pinnae blunt or subacute — *D. cristata*
            11. **Blades oblong; pinnae long acuminate** — ***D. Clintoniana***

7. Fronds tripinnate or tripinnatifid, the ultimate segments spiny-toothed, *12*
   12. Indusium glabrous; inner pinnules of basal row longer than the next outer ones *D. spinulosa*
   12. Indusium glandular-puberulent; inner pinnules of basal row shorter than next outer ones *D. intermedia*

D. Phegopteris (L.) Christens. Long beech fern. Cool ravines, along rocky streams. Rare below 300 m. elevation, but frequent in the higher hills northeastward. Stephentown Center, *House 21667;* hills west of Berry Pond, *3772;* Mount Lebanon, *House 15599;* Austerlitz, *2153;* Spencertown, along a creek about 4 miles southeast of town, *1867;* Bashbish Gorge, *3563;* New Forge, along Taghkanic Creek, *3498;* 1 mile southeast of North Chatham, *1111.*

D. hexagonoptera (Michx.) Christens. Broad beech fern. Rich moist woods and cool ravines; rather frequent in the clays of the river valley; infrequent elsewhere. 2 miles south-southwest of Green River, *3525;* south of Fox Hill, Ancram, *3415;* north of Stuyvesant, along Mill Creek, *1553;* 1 mile north of Kinderhook, *1462;* Columbiaville, *1505;* 4 miles north of Nassau, *House 22759.*

D. disjuncta (Ledeb.) C. V. Mort. (Rhodora 43: 217. 1941) Oak fern. Cool ravines along rocky streams. Rather rare in the higher hills to the eastward; unknown below 300 m. elevation, except in the cool gorge of Bashbish Brook, *3565.* Brainard, *House 21347;* Perry Peak, Canaan, *3655;* Austerlitz, *Whitney 848;* 4 miles southeast of Spencertown, *1865;* Pine Plains, *Hoysradt* (PENN).

D. Thelypteris (L.) Gray. Marsh fern. Wet places; common. Very abundant in swamps and wet meadows; found also 1 mile south of Canaan Center on limestone talus, in a well-drained situation. Represented in our area only by var. **pubescens** (Lawson) Nakai.

D. simulata Davenp. Sphagnous hummocks in swampy woods; rare. Abundant 1 mile west of Lebanon Springs, *3671;* between Long Pond and Round Pond, Berlin, *4743* (USNA); [Near Long Pond, Berlin, *House 29339*].

D. noveboracensis (L.) Gray. New York fern. Woodlands, often in dry soil; frequent. Canticoke Swamp; Canaan Center; 4 miles southeast of Spencertown; Kinderhook (PENN); Stuyvesant Falls; Tivoli (TRT); north of Brace Mountain.

D. cristata (L.) Gray. Wooded swampy places; frequent, especially east of the the Hudson Valley. Canaan Center; 3 miles southeast of Harlemville; North Chatham; 2 miles south of Copake Lake (TRT); Pine Plains, *Hoysradt* (PENN); 1 mile north of Kinderhook.

D. Clintoniana (D. C. Eat.) Dowell (*D. cristata* var. *Clintoniana* of *Gray's Manual*). Wooded swamps, infrequent. (Canaan, *2116;* 3 miles north of Ancramdale, *1081;* Niverville, *1137;* 1 mile north of Kinderhook, *146* (PENN).

D. Goldiana (Hook.) Gray. Goldie's fern. Rich moist woods; rare. 2 miles south of Flatbrook, *3610;* No Bottom Pond, *1941;* Pine Plains, *Hoysradt* (PENN).

D. marginalis (L.) Gray. Evergreen wood fern. Woods; common. Most abundant in rocky places on wooded hillsides.

D. spinulosa (O. F. Muell.) Watt. Moist, usually swampy, woodlands. Frequent eastward, at higher elevations, but rare in the Hudson Valley. Brainard; Canticoke Swamp; North Chatham; 2 miles south of Copake Lake (TRT); 1.5 miles south of Ancramdale; 1 mile north of Kinderhook.

D. intermedia (Muhl.) Gray. (*D. spinulosa* var. *intermedia* of *Gray's Manual*). Woodlands; frequent. Rather scarce in the Hudson Valley, but very abundant eastward in woods, swamps and cool ravines. Lebanon Springs; Brainard; North Chatham; Austerlitz; 4 miles southeast of Spencertown; Bashbish Gorge (Figure 4); 4 miles southeast of Harlemville; Niverville; Kinderhook.

D. ×Boottii (Tuckerm.) Underw. Locally abundant where the parent species (*D. cristata, D. intermedia*) are found growing together. Seen at Queechy Lake and Old Chatham, *McVaugh.* West of Douglas Knob, New Lebanon, *2115;* Canaan Center, *1047;* North Chatham, in a tamarack swamp 2 miles southeast, *1152;* 2 miles south of Copake Lake, *2608* (TRT). A supposed hybrid between *D. cristata* and *D. spinulosa* was collected at Brainard, *House 21401.*

7. **Anchistea** Presl

A. virginica (L.) Presl. (*Woodwardia* of *Gray's Manual*). Chain fern. In swamps, in acid soil; rare. North of Brainard, *House 7173;* Pine Plains, *Hoysradt* (NY, PENN).

8. **Camptosorus** Link

C. rhizophyllus (L.) Link. Walking fern. Shaded limestone rocks, where abundant. Occurs rarely on the calcareous shales of the Hudson Valley. New Lebanon, *Iva Allen;* hill north of Copake, *832;* Poelsburg, *331* (PENN); town of Stockport, in gorge near river, *247* (PENN); 3 miles north of Claverack, *274;* 2.5 miles west of Clermont, *3270.*

9. **Asplenium** L. Spleenwort

1. Blades pinnatifid or pinnate only below, the apices long-attenuate *A. ebenoides*

1. Blades pinnate most of their length, the apices not long-attenuate, *2*

- *2.* Blades narrow, linear or linear-elliptic, once pinnate only, the pinnae toothed, or lobed, but not pinnatifid, *3*
  - *3.* Pinnae subopposite, orbicular or short-oblong, not lobed at base *A. Trichomanes*
  - *3.* Pinnae mostly alternate, deltoid-oblong, the fertile ones with a lobe at base *A. platyneuron*
- *2.* Blades ovate or deltoid-oblong, 2- to 3-pinnatifid, the primary divisions pinnate or pinnatifid, *4*
  - *4.* Stipe green except at the very base; pinnules obovate, often obtuse; blade ovate, twice or three times pinnate *A. Ruta-muraria*
  - *4.* Stipe brown on lower part; pinnules rhombic-elliptic, subacute; blade deltoid-oblong, once or twice pinnate *A. montanum*

A. ebenoides R. R. Scott. (×*Asplenosorus ebenoides* of *Gray's Manual*)[1]. Known only from limestone talus, west side of Risedorph Hill, Pine Plains, *House 21032* (See Amer. Fern Jour. 23: 122. 1933).

A. platyneuron (L.) Oakes. Rocky woods and in crevices; frequent. Most abundant on the shaly soils of the Hudson Valley; unknown from the higher hills to the eastward. Brainard; North Chatham; Pulvers, town of Ghent; Stissing Mountain (TRT); Snyderville; Poelsburg; Kinderhook (PENN); Stuyvesant Falls (PENN); Blue Hill; Tivoli.

[1] If *Camptosorus* and *Asplenium* are maintained as separate genera, this should be referred to the intergeneric hybrid genus *Asplenosorus* Wherry.

A. Trichomanes L. Maiden-hair spleenwort. Rocky wooded slopes and crevices in rocks; frequent. Not known from the higher elevations eastward. Curtis Mountain; Pulvers, town of Ghent; Stissing Mountain (TRT); 3 miles south of Kinderhook (PENN); Becraft Mountain (PENN); Blue Hill; 1 mile south of Madalin. Copake Falls, according to Burnham (1913).

A. Ruta-muraria L. *(A. cryptolepis* of *Gray's Manual).* Crevices in north- or west-facing limestone rocks; infrequent. Canaan Center, *2316;* Old Chatham, *635;* hill north of Copake, *833;* Pine Plains, *Hoysradt* (PENN); 1 mile southwest of West Ghent, *3297;* 3 miles north of Claverack, *275;* Becraft Mountain, *321* (PENN). I am unable clearly to separate *A. cryptolepis* Fern. from the European *A. Ruta-muraria,* as far as Columbia County material is concerned (figure 5).

A. montanum Willd. On dry (acid) rocks; rare. Reported from Hudson by Stebbins (1830); Pine Plains, *Hoysradt* (PENN). The Pine Plains locality has not been relocated, but was no doubt originally on Stissing Mountain.

10. Athyrium Roth

1. Fronds once pinnate, the pinnae deeply pinnatifid, but not truly pinnate; small veins of the lobes of the pinnae never forking. *A. thelypteroides*

1. Fronds twice pinnate. (Sterile fronds which are not truly twice pinnate may be distinguished by the smallest veins, some of which are once or twice forked.) *A. angustum*

A. angustum (Willd.) Presl. (*A. Filix-femina* var. *Michauxii* of *Gray's Manual*). Lady fern. Wet places, dry woodlands, or by roadsides; common.

A. thelypteroides (Michx.) Desv. Silvery spleenwort. Rich moist woods and cool ravines; frequent. Local in the Hudson Valley, and much more abundant eastward. New Lebanon, *House 21296;* No Bottom Pond, *1331;* Spencertown, *1855;* Copake Falls, *Britton et al.* (NY); Niverville, *1140;* 1 mile north of Kinderhook, *676.*

11. Adiantum L.

A. pedatum L. Maiden-hair fern. Rich soil in woods; common (figure 6).

12. Pteridium Gleditsch

P. latiusculum (Desv.) Hieron. (*P. aquilinum* var. *latiusculum* of *Gray's Manual*). Brake, Bracken. Poor or sandy soils; common. Abundant in open fields or in light shade.

13. Pellaea Link

1. Stipe and rachis more or less clothed with crisped hairs *P. atropurpurea*

1. Stipe and rachis glabrous, shining *P. glabella*

P. atropurpurea (L.) Link. Purple cliff brake. Exposed north- and west-facing limestone rocks, where abundant. More common at low elevations near the Hudson River. Old Chatham, *1402* (PH); 3 miles south of Kinderhook, *195* (PENN); Poelsburg, *333* (PENN); 3 miles north of Claverack, 310; 1.5 miles north of Tivoli, *2982* (TRT).

P. glabella Mett. Known only from the face of a north-facing limestone cliff near Old Chatham, *634, 1405, 1894* (figure 7).

14. Polypodium L.

P. virginianum L. Rocks and rocky banks; common throughout, often forming large patches on rocks.

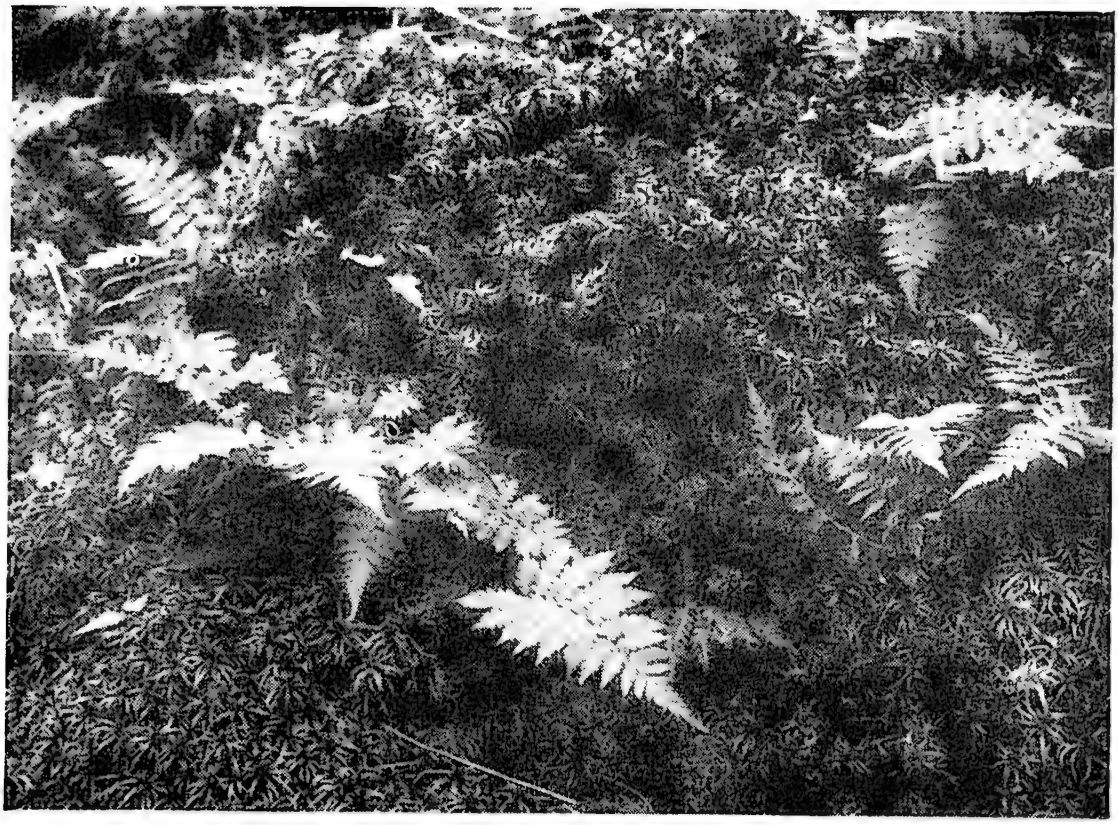

Figure 2. *Dryopteris simulata* in a sphagnous woods about 1 mile west of Lebanon Springs

Figure 3. *Dryopteris Goldiana* on limestone talus at No Bottom Pond

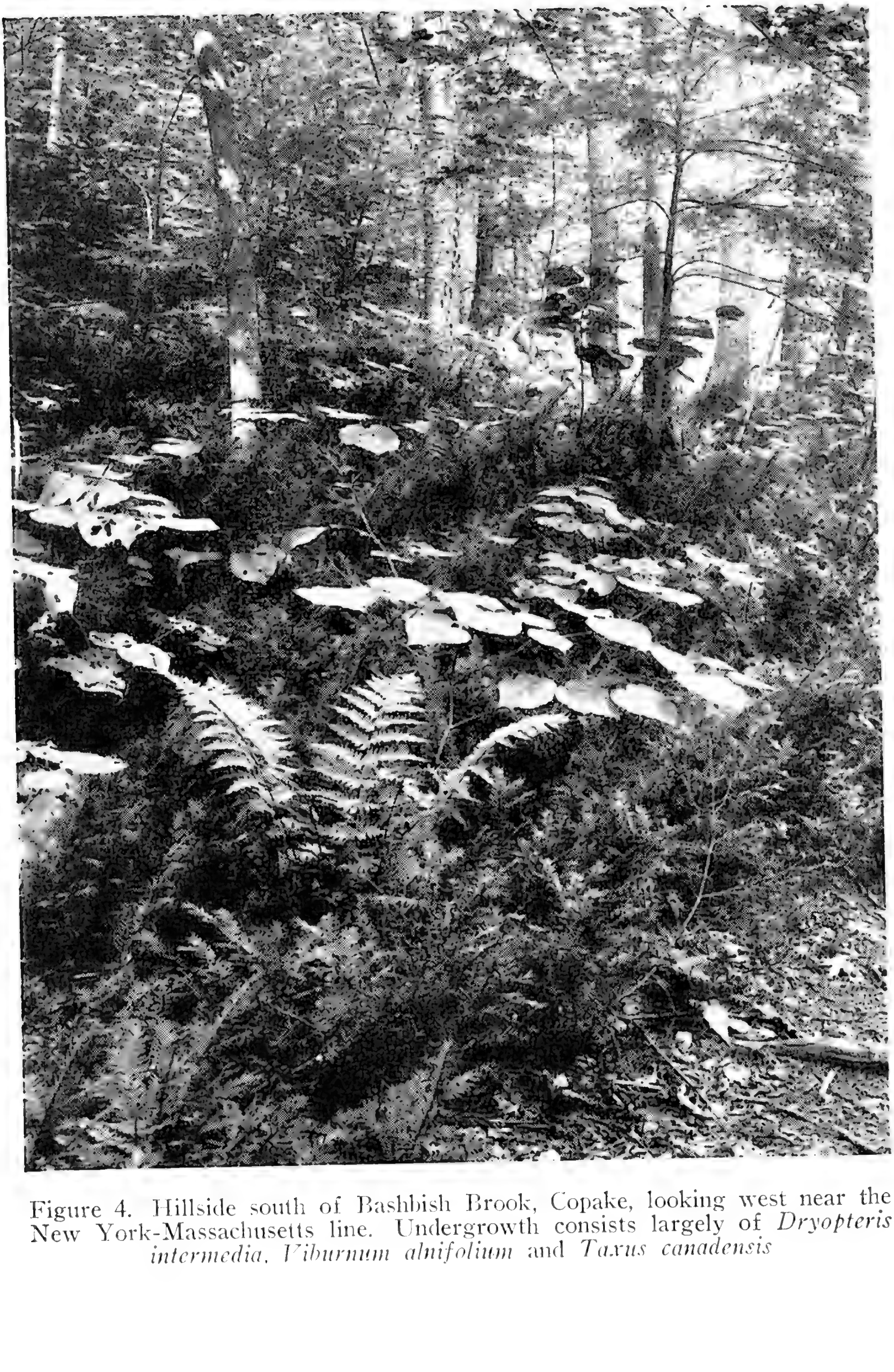

Figure 4. Hillside south of Bashbish Brook, Copake, looking west near the New York-Massachusetts line. Undergrowth consists largely of *Dryopteris intermedia, Viburnum alnifolium* and *Taxus canadensis*

Figure 5. Limestone cliff near Old Chatham showing growth of *Asplenium Ruta-muraria*. At the right is *Pellaea atropurpurea*.

Figure 6. Shady woods near Old Chatham, showing a dense growth of *Adiantum pedatum* on a calcareous soil

Figure 7. *Pellaea glabella* on the face of a vertical limestone cliff near Old Chatham

Figure 8. Flowering plants of *Sagittaria subulata* exposed at low tide on the mud flats at the mouth of Stockport Creek

Division II. SPERMATOPHYTA

Class I. GYMNOSPERMAE

PINACEAE (Pine Family)

1. Leaves alternate or in clusters, needlelike or narrowly linear, *2*
  2. Leaves in clusters of 2 or more (except on some young shoots), *3*
    3. Leaves 2 to 5 in each cluster, evergreen **1. Pinus**
    3. Leaves numerous in each cluster, deciduous **2. Larix**
  2. Leaves alternate, not in clusters, *4*
    4. Leaves needle-like, 4-angled; leaf scars raised on short pedicel-like projections; cones hanging, falling entire **3. Picea**
    4. Leaves linear, flat; leaf scars not raised on pedicel-like projections, *5*
      5. Cones hanging, falling entire, 1.5 to 2.5 cm. long **4. Tsuga**
      5. Cones erect, with persistent axis and deciduous scales, 6 to 10 cm. long **5. Abies**
 Leaves opposite or whorled, scalelike (if needlelike, always opposite or whorled), *6*
  6. Branchlets strongly flattened; fruit a dry cone **6. Thuja**
  6. Branchlets not strongly flattened; fruit fleshy, berrylike, blue **7. Juniperus**

1. Pinus L. Pine

1. Leaves 5 in each cluster; cone scales thin, without spiny tips *P. Strobus*
1. Leaves 2 or 3 in each cluster; cone scales woody, thickened at apex, *2*
  2. Leaves 3 in each cluster; cone scales with stiff recurved prickles *P. rigida*
  2. Leaves 2 in each cluster; cone scales without prickles *P. resinosa*

P. Strobus L. White pine. Woods, in all kinds of habitats; common. This tree is very abundant in all parts of the county and seeds itself quickly, often taking over old fields and forming new stands.

P. rigida Mill. Pitch pine. Dry sandy soil, in woods or in the open, or on rocks; common. Very abundant on the sandy soils in Kinderhook and on the rocky summits of the hills in the southeastern part of the county.

P. resinosa Ait. Red pine. Woods; rare. 2 miles east of Kinderhook, *314;* 1 mile northeast of Boston Corners, on rocks at an elevation of 500 m., *2279;* north of West Lebanon, *D. B. Cook.* Isolated trees in the towns of Stuyvesant and Taghkanic. Dense natural seeding forming a nearly pure stand near Fowlers' Lake.

2. Larix Adans. Larch

1. Cone 1.5 to 2 cm. long, with 12 to 15 scales *L. laricina*
1. Cone 2 to 3.5 cm. long, with 40 to 50 scales *L. decidua*

L. laricina (DuRoi) K. Koch. American larch, Tamarack. Abundant in calcareous marshes and wet meadows in Canaan, Copake and Ancram, and in the acid bogs of the county, chiefly in the town of Kinderhook. Known from the "Fingar Marsh," town of Gallatin.

L. decidua Mill. European larch. Well established in an old field about 2 miles east of Austerlitz, *2281*

3. Picea Link Spruce

1. Leaves mostly 12 to 15 mm. long, dark or yellowish green; cones elongated-ovoid, usually 3 to 4 cm. long *P. rubens*

1. Leaves mostly 6 to 10 mm. long, pale bluish green, glaucous; cones short-ovoid, usually 2 to 3 cm. long. ***P. mariana***

P. rubens Sarg. Red spruce. Common on the Rensselaer Plateau, at the northeastern limits of our area; there forming extensive swamp forests with larch and balsam fir. Otherwise known only from Perry Peak, Canaan, at an elevation of about 570 m., *House 21200.*

P. mariana (Mill.) BSP. Black spruce. Sphagnum bogs; rather rare. ½ mile south of Niverville, *367;* reported from Lebanon Springs by Harrison (1887, as *Abies nigra*); reported from Pine Plains by Hoysradt and from Croghan Hill Marsh, town of Ancram. These reports are unverified, except that the Lebanon Springs report may refer to Taplins' Pond, where this species occurs. A few stunted trees are still to be found in a swamp north of the West Ghent Church, Ghent.

4. **Tsuga** (Endl.) Carr.

T. canadensis (L.) Carr. Hemlock. Cool shady woods; very common. Locally a dominant tree in ravines and on north-facing slopes.

5. **Abies** Hill

A. balsamea (L.) Mill. Balsam fir, Balsam. Common on the Rensselaer Plateau, at the northeastern limits of our area, where it forms extensive swamp forests with larch and red spruce at elevations above 500 m. Otherwise unknown, although reported from Kinderhook by Woodworth (1840, as *Pinus balsamea*) and from Stissing Mountain by Hoysradt (1875-79).

6. **Thuja** L.

T. occidentalis L. Arbor Vitae, "White cedar." Steep shale banks and outcrops and in woods near the Hudson River; there abundant. Unknown elsewhere, except on a calcareous bluff on Becraft Mountain, *345,* and as a swamp tree on Rogers Island. Poelsburg, *236;* Columbiaville, *4041.* Woodworth (1840) reported *Cupressus thyoides* from Kinderhook; his plant was probably *Thuja occidentalis,* rather than the coastal "White cedar," *Chamaecyparis thyoides* (L.) BSP., which is unknown in our area.

7. **Juniperus** L. Juniper

1. Leaves whorled, needle-shaped, 8 to 14 mm. long; plant a low bush with spreading branches *J. communis*

1. Leaves opposite, scalelike, 0.5 to 1.5 mm. long (or in the juvenile state sharp, longer, needle-shaped); plant erect, forming a tree *J. virginiana*

J. communis L. Low or bush juniper. Dry woods and fields; local. Usually only 1 or 2 plants at a station. Woods south of Copake Lake, *3467;* 2 miles east of Elizaville, *3285;* 2 miles southeast of Churchtown, *3511;* Blue Hill, *249.* Known also from just northeast of Kinderhook Lake; 2 miles south of Kinderhook; and hills west of Fowlers' Lake. Represented in our area only by var. **depressa** Pursh.

J. virginiana L. "Red cedar." Woods and open fields; infrequent or rare in the eastern part of the county, but becoming very abundant in the Hudson Valley, especially on the calcareous shales where it sometimes forms pure stands. Represented in our area only by var. **crebra** Fern. & Grisc.

TAXACEAE (Yew Family)

Taxus L.

T. canadensis Marsh. American yew. Cool shady or swampy woods; infrequent, but widely distributed. Canticoke Swamp, *1750;* Bashbish Gorge, *3561;* 3 miles north of Castleton, *3974;* 3 miles south of Muitzes Kill, *289;* Stuyvesant Falls, *238;* known also from west of Lebanon Springs; 1 mile east of Canaan Center; 1 mile east of Valatie; bank of the Hudson River below mouth of Roeliff Jansen Kill; 2 miles east of Spencertown; Mount Everett.

Class II. ANGIOSPERMAE

Subclass I. MONOCOTYLEDONEAE

TYPHACEAE (Cattail Family)

Typha L. Cattail

1. Staminate and pistillate parts of the spike contiguous; pistillate part of the spike when mature 2.5 cm. in diameter; leaves 12 to 23 mm. in width; pollen grains in 4's *T. latifolia*
1. Staminate and pistillate parts of the spike separated by a naked interval; pistillate part of the spike when mature 10 to 12 mm. in diameter; leaves 3 to 15 mm. wide; pollen grains single *T. angustifolia*

T. latifolia L. Wet or swampy places; common.

T. angustifolia L. Tidal marshes along the Hudson River, where abundant. Elsewhere local, sometimes forming a large stand, as at White Mills Pond, Chatham, *1032.* 1.5 miles north of Kinderhook, *1422;* Rogers Island, *2594.* Reported from Copake Falls, Stetson (1913).

SPARGANIACEAE (Bur-reed Family)

Sparganium L. Bur-reed

1. Stigmas 2; fruit sessile *S. eurycarpum*
1. Stigma 1; fruit short-pedicelled, *2*
  2. Fruiting heads sessile in the axils of the leaves, or the lower ones peduncled in the axils *S. americanum*
  2. At least some of the fruiting heads sessile on the stem some distance above a leaf axil *S. chlorocarpum*

S. eurycarpum Engelm. Muddy places and in shallow water; abundant in tidal marshes along the Hudson River and known from several localities in the adjacent valley. Otherwise unknown. Kinderhook Lake, *1228;* along creek near Kinderhook, *1375;* Hudson, South Bay, *House 20495;* 2 miles south of Tivoli, *2782.*

S. americanum Nutt. Muddy borders of ponds and streams; frequent. Not reported from the river shores. Tackawasick Lake, *Muenscher & Clausen 4142* (CU); Queechy Lake, *Muenscher & Clausen 4141* (CU); Chatham, *Harriet Wheeler* (CU); Forest Lake, *2051;* Mount Riga Station, *3370;* 1 mile east of Valatie, *1488;* Kinderhook, *2097;* 2 miles east of Germantown, *2932.*

S. chlorocarpum Rydb. Muddy borders of ponds and streams; with the last, but less frequent. Crooked Lake, Sand Lake, *House 21690;* 2 miles south of Flatbrook, *3612;* New Forge, *3490;* 3 miles north of Ancramdale, *3904;* Kinderhook Lake, *House 20958;* 2 miles east of Valatie, *1882.* The last 2 collections cited above may be in part the var. **acaule** (Beeby) Fern.

NAJADACEAE[1] (Pondweed Family)

1. Flowers perfect, in peduncled spikes or clusters; leaves alternate or the upper ones sometimes opposite **1. Potamogeton**
1. Flowers unisexual, axillary; leaves opposite or in 3's, *2*
2. Leaves serrulate, dilated at base; pistil 1 only, spindle-shaped, symmetrical, with no lateral keels or teeth **3. Najas**
2. Leaves entire, long and threadlike; pistils 2 to 6, asymmetric, undulate or toothed on one side **2. Zannichellia**

1. Potamogeton[2] L. Pondweed

1. Leaves of two sorts; floating ones more or less coriaceous, with a dilated petioled blade, different in form from the thinner submersed ones which may be wanting, *2*
2. Submersed leaves filiform or very narrowly linear, at most 2 mm. wide, often wanting or reduced to the petiole only, *3*
3. Submersed leaves wanting or reduced to petiole only, *4*
4. Blade of floating leaves subcordate; fruit scarcely keeled *P. natans*
4. Blade of floating leaves tapering to base; fruit 3-keeled when dry *P. nodosus*
3. Submersed leaves present, thin and delicate, *5*
5. Spikes 1.5 to 3 cm. long; sides of the seed not at all impressed *P. Oakesianus*
5. Spikes 0.5 to 1.5 cm. long, *6*
6. Fruits flattened, hollowed on the sides, not beaked, the spiral curve of the embryo clearly evident through the thin coat; stipules of some or all the submersed leaves adnate to the base of the leaf *P. Spirillus*
6. Fruits flattened, not hollowed on the sides, plainly beaked, the form of the embryo not conspicuously visible; stipules all free *P. Vaseyi*
2. Submersed leaves lanceolate to ovate, if linear more than 2 mm. wide, *7*
7. Submersed leaves linear and ribbonlike, with a broad coarsely cellular-reticulate space each side of the midrib *P. epihydrus*
7. Submersed leaves broader, *8*
8. Floating leaves with 30 to 50 nerves *P. amplifolius*
8. Floating leaves with fewer nerves, *9*
9. Blade of floating leaves 1.5 to 6.0 cm. long; fruiting spikes 1 to 3 cm. long; fruit 2.5 mm. long *P. gramineus*
9. Blade of floating leaves 5 to 12 cm. long; fruiting spikes mostly 3 to 7 cm. long; fruit 3 to 4 mm. long, *10*
10. Upper submersed leaves on petioles 8 to 15 cm. long, frequently wanting; floating leaves mostly obtuse, sometimes acute, not really apiculate *P. nodosus*
10. Upper submersed leaves on petioles 1 to 4 cm. long, usually present; floating and submersed leaves subacute and apiculate ***P. illinoensis***
1. Leaves all submersed and similar, 11
11. Leaves lanceolate, oblong, or broader, *12*

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[1] *Potamogeton* and *Zannichellia* are frequently placed in the segregate family *Zosteraceae* as in *Gray's Manual.*

[2] Many helpful data on *Potamogeton* in our area are to be found in Muenscher's report on The Aquatic Vegetation of the Mohawk Watershed (A Biological Survey of the Mohawk-Hudson Watershed; Suppl. to the 24th Ann. Report N. Y. State Conservation Dept., pp. 228-249. 1935). **Pages under Muenscher refer to this publication.**

12. Leaves sessile or short-petioled, not clasping, *13*
13. Leaves finely and sharply serrulate *P. crispus*
13. Leaves entire but sometimes with puckered or undulate, but not serrulate, margins, *14*
14. Fruiting spikes mostly 3.8 to 5.5 cm. long *P. illinoensis*
14. Fruiting spikes mostly 1 to 3 cm. long *P. gramineus*
12. Leaves clasping or half-clasping, *15*
15. Leaves finely and sharply serrulate *P. crispus*
15. Leaves entire, not serrulate, *16*
16. Leaves half-clasping, elongate, with rounded cucullate tips; stipules 2 to 8 cm. long; stem whitish *P. praelongus*
16. Leaves cordate-clasping, with tapering plane tips; stipules 1 to 2 cm. long; stems green, *17*
17. Stipules conspicuous, at least as shreds; leaves with 3 to 7 prominent nerves; fruit 3.5 to 4.5 mm. long *P. Richardsonii*
17. Stipules rarely developed; leaves with one prominent nerve; fruit 2.5 to 3.2 mm. long *P. perfoliatus*
11. Leaves linear to setaceous, *18*
18. Leaves ribbonlike, 2 mm. or more wide, with a broad, coarsely cellular-reticulate space each side of the midrib *P. epihydrus*
18. Leaves narrower; if occasionally 2 mm. wide, without such a broad cellular-reticulate space, *19*
19. Stipules united with the sheathing base of the leaf, *20*
20. Leaves 3 mm. wide or less, entire, neither auricled nor definitely 2-ranked *P. pectinatus*
20. Leaves 4 to 8 mm. wide, finely and sharply serrate, auricled at base and stiffly 2-ranked *P. Robbinsii*
19. Stipules all free from the leaf blades, *21*
21. Leaves 9- to 35-nerved *P. zosteriformis*
21. Leaves 1- to 7-nerved, *22*
22. Stipules connate, forming cylinders with margins united at least below the middle, in age rupturing and often shredded at tip, *23*
23. Leaves without basal glands; peduncles clavate, 0.4 to 1.0 cm. long; spike subcapitate, 2 to 5 mm. long *P. foliosus*
23. Leaves with a pair of basal glands; peduncles filiform, 1 to 9 cm. long; spike interrupted, cylindric, 6 to 15 mm. long, *24*
24. Stipules strongly fibrous, becoming whitish *P. strictifolius*
24. Stipules scarious-membranaceous or subherbaceous, greenish or brownish, only delicately veined *P. pusillus*
22. Stipules flat or convolute, the margins often inrolled but not connate, *25*
25. Leaves gradually tapering to bristle tips; stipules attenuate to slender tips *P. Hillii*
25. Leaves obtuse to acute, if attenuate, hardly bristle-tipped; stipules obtuse, *26*
26. Leaves fulvous or reddish green, 2 to 4 mm. wide, rounded at tip; fruit 3 to 4 mm. long *P. obtusifolius*
26. Leaves green, 0.3 to 2.4 mm. wide, obtuse to acute, fruit 2 to 2.8 mm. long *P. Berchtoldi*

P. natans L. Shallow water in lakes; frequent. Queechy Lake, *2108;* Sutherland Pond, *2132;* Bells' Pond, *3304;* Kinderhook and Tackawasick Lakes, according to Muenscher (p. 232).

P. Oakesianus Robbins. Pine Plains, according to Hoysradt (1875-79). Otherwise unknown. The specimens of *Potamogeton* reported by Hoysradt from Pine Plains were all identified by J. W. Robbins. *P. Oakesianus,* one of the species described by Robbins, is thus thought to be included in our list upon good authority, although no specimen has been seen.

P. Vaseyi Robbins. "Mouth of the Catskill," according to Svenson (1935). Except for this report from the Hudson Estuary, the species is unknown from our area.

P. Spirillus Tuckerm. Lakes and ponds, in shallow water; frequent. Kinderhook Lake, *House 19608*; Taghkanic Lake, *2016*; Forest Lake, *2072*; Berry Pond, *3777;* Lebanon Springs, *A. K. Harrison* (the report of *P. diversifolius* Raf. in House's Annotated List, p. 52, is apparently based upon this species); Copake Lake *Muenscher & Clausen 4221* (CU); reported by Svenson (1935) from the Hudson Estuary but otherwise unknown there.

P. epihydrus Raf. Shallow water, lakes and streams, infrequent or rare. Tackawasick Lake, *Muenscher & Clausen 4188* (CU); rare at mouth of Stockport Creek, Hudson River, Muenscher, p. 234. Berry Pond, *3778;* East Nassau, *House 21937.*

P. amplifolius Tuckerm. Ponds, lakes and quiet streams; common. Often in deep water. Sutherland Pond, *2133;* Taghkanic Lake, *2017;* Waldorf Pond, *3173;* Merwins' Lake, *1240;* Queechy Lake, *2099;* Copake Lake, *Muenscher & Clausen 4163* (CU); Stony Creek, Madalin, *2766* (PENN).

P. illinoensis Morong. Deep water in lakes; common. Queechy Lake, *2106;* Copake Lake, *Muenscher & Clausen 4237* (CU); Pine Plains, *Peck;* Kinderhook Lake, *Muenscher & Clausen 4234* (CU); Knickerbocker Lake, *1992.* Apparently all plants from our area referred to the European *P. lucens* L., are actually, *P. illinoensis.* This includes the report of *P. lucens* var. *Connecticutensis* from Pine Plains (Morong, 1893).

P. gramineus L. In lakes and ponds; frequent. Occurring locally in colonies. No Bottom Pond, *1962;* Taghkanic Lake, *2007;* Pine Plains, according to Morong (1893, where reported as *P. heterophyllus* Schreb., forma *maximus*); Tackawasick, Kinderhook, Queechy and Copake Lakes, according to Muenscher (p. 232).

P. nodosus Poir. Shallow water in lakes and quiet streams; frequent. Knickerbocker Lake, *Brown 509;* Kinderhook Lake, *House 18863;* east of Valatie, in Kinderhook Creek, *1878;* Silvernails, in Roeliff Jansen Kill, *1089;* New Forge, in Taghkanic Creek, *3495;* Robinson Pond, *House 20602;* Hudson, Hudson River, *Muenscher & Clausen 4159* (CU); Rogers Island, *3735.*

P. crispus L. Lakes and creeks; infrequent. Kinderhook Lake, *House 15553;* Knickerbocker Lake, *3178;* Kinderhook, in Kinderhook Creek, *2095;* common in Copake Lake, according to Muenscher, p. 243.

P. praelongus Wulfen. Deep water in the larger lakes; frequent and sometimes very abundant. Kinderhook Lake, *House 15547* and *Muenscher & Clausen 4201* (CU); Queechy Lake, *2107* and *Muenscher & Clausen 4202* (CU); Copake Lake, *Muenscher & Clausen 4203* (CU); Tackawasick Lake, according to Muenscher, p. 243.

P. Richardsonii (Ar. Benn.) Rydb. Plants apparently of this species, although sometimes approaching the next, have been found in the Hudson River; Poelsburg, *3815;* Columbiaville, *3718;* in the Mohawk River, according to Muenscher, p. 243.

P. perfoliatus L. var. **bupleuroides** (Fern.) Farw. Abundant in tidewater along the Hudson River; otherwise known only from Copake Lake, *Muenscher & Clausen 4167* (CU). The plants of the latter collection seem to

approach *P. Richardsonii*. Coeymans, Albany County, *Muenscher & Clausen 4169* (CU); mouth of Stockport Creek, *idem 4170* (CU); between Hudson and Athens, *idem 4168* (CU); Rogers Island, *3736*.

P. Robbinsii Oakes. Shallow water in lakes; locally abundant. Nassau Lake, *Muenscher & Clausen 4213* (CU); Copake Lake, *idem 4214* (CU); Forest Lake, *2064;* Taghkanic Lake, *2013*.

P. pectinatus L. In lakes and in the Hudson River, "widespread . . . but nowhere abundant" (in Hudson-Mohawk watershed), according to Muenscher, p. 243. Hudson, *Muenscher & Clausen 4198a* (CU); Knickerbocker Lake, *Brown 508*.

P. Hillii Morong. Pine Plains, *L. H. Hoysradt,* according to Morong (1893). Specimen at New York Botanical Garden, according to Fernald (1932), who gives the collector's name as Hoysralt. Otherwise unknown.

P. zosteriformis Fern. Lakes; common. Rare in the Hudson River, whence reported by Muenscher, p. 243, and by Svenson ("mouth of the Catskill") (1935); Queechy Lake, *2109;* Waldorf Pond, *3171;* Sutherland Pond, *2134;* Copake Lake, *Muenscher & Clausen 4230* (CU); Knickerbocker Lake, *Brown 512* (see Fernald, 1932); Bells' Pond, *3303*.

P. obtusifolius Mert. & Koch. Pine Plains, *L. H. Hoysradt,* according to Morong (1893); specimen at Pomona College, according to Fernald (1932). Otherwise unknown.

P. Berchtoldi Fieber. "Locally common in shallow bays of lakes, ponds and in sluggish streams and in backwaters along the Mohawk River and Hudson River" (Muenscher, p. 243). Tackawasick Lake, *Muenscher & Clausen 4260* (CU); Kinderhook Lake, *idem 4257* (CU); Nassau Lake, *idem 4261, 4262* (CU); Hudson, *idem 4253* (CU); reported also from Queechy and Copake Lakes (Muenscher, p. 232).

P. strictifolius Ar. Benn. Pine Plains, *C. H. Peck* (specimen determined by M. L. Fernald, 1936). Otherwise unknown.

P. pusillus L. In lakes and in the Hudson River; infrequent or perhaps commonly overlooked. "Infrequent in shallow ponds and sluggish streams" (Muenscher, p. 243). Waldorf Pond, *3172;* Copake Lake, *Muenscher & Clausen 4249* (CU); Hudson, in river, *idem 4240* (CU); Miller Pond, Stissing Mountain, *3874*.

P. foliosus Raf. Lakes and sluggish streams. Sutherland Pond, *2130;* Queechy Lake, *2102;* Mill Creek, town of Stuyvesant, *1551*. The collections of this species were determined by Fernald, 1936.

2. **Zannichellia** L.

Z. palustris L. Mud and shallow water along the Hudson River; otherwise unknown. Coeymans, Albany County, *Muenscher & Clausen 4293* (CU); Hudson, *Muenscher & Clausen 4292* (CU); Columbiaville, *3716*. Represented in our area only by var. **major** (Boenn.) W. D. J. Koch.

3. **Najas** L.

1. Leaf bases broadly and truncately lobed or auriculate, *2*
- 2. Leaf bases broadly and truncately lobed, the lobes not strongly spiny-toothed; leaves somewhat recurved, narrow but not capillary, coarsely serrate, the serrations evident to the naked eye — *N. minor*
- 2. Leaf bases auriculate, the auricles scarious and decidedly spiny-toothed; leaves not recurved; blades very narrow, almost capillary, minutely saw-toothed — *N. gracillima*

1. Leaf bases not broadly and truncately lobed nor auriculate, enlarged but little and sloping, *3*
3. Seeds ellipsoid, shining, covered with a fine network consisting of 30 to 40 longitudinal rows of areolae; style filiform, 1 to 2 mm. long *N. flexilis*
3. Seeds ellipsoid, dull, with 10 to 20 rows of areolae around the seed; style stout, 0.5 mm. long or less *N. guadalupensis*
3. Seeds long and slender, dull, nearly linear, with 50 to 60 rows of areolae; style stout, 0.7 to 1.2 mm. long *N. Muenscheri*

N. minor All. Tidewater in the Hudson River, where rather frequent. Stuyvesant, *Muenscher & Clausen 4280* (CU); Nutten Hook, *4509;* Rogers Island, *4460.* First reported from America by Muenscher (1935, pp. 234, 244).

N. flexilis (Willd.) Rostk. & Schmidt. Lakes and quiet streams, common.

N. gracillima (A. Br.) Magnus. Knickerbocker Lake, *1985;* otherwise unknown in our area.

N. guadalupensis (Spreng.) Magnus. Lakes and ponds, locally abundant, Nassau Lake, *Muenscher & Clausen 4284* (CU); Kinderhook Lake, *idem 4285* (CU); Knickerbocker Lake, *1990.*

N. Muenscheri Clausen. Tidal mud flats along the Hudson River, where locally abundant. Hudson, *Muenscher & Clausen 4286* (CU); Columbiaville, *idem 4289* (CU); South Bay, Tivoli, *Muenscher & Curtis 5494.*

JUNCAGINACEAE (Arrow-grass Family)

Scheuchzeria L.

S. palustris L. Known in our area only from a bog at Kinderhook Lake, *Brown 114.* Well known in Rensselaer County and collected in the mountain ponds in the town of Salisbury, where overlooking but just out of the Columbia County drainage: Bingham Pond, *C. H. Bissell* (GH); Mount Riga Pond, "N. Y.," *Hoysradt* (MICH).

ALISMATACEAE (Water-plantain Family)

1. Carpels in a single ring **1. Alisma**
1. Carpels in several series, in a dense head, *2*
2. Lower flowers of the inflorescence with both pistils and stamens **2. Lophotocarpus**
2. Lower flowers of the inflorescence with pistils only **3. Sagittaria**

1. Alisma L.

A. subcordatum Raf. "Water plantain." Wet places; common in the river valley and adjacent territory, but not recorded from the higher elevations to the eastward. Kinderhook Lake, *House 15538;* Kinderhook, *1249;* South Bay, Hudson, *House 20493.*

2. Lophotocarpus Th. Durand

L. spongiosus (Engelm.) J. G. Sm. Tidal mud along the Hudson River. Coxsackie, *Muenscher & Clausen 4298* (CU). No specimens have been seen from Columbia County, but Muenscher (1935) reports that the species grows near the mouth of Stockport Creek, at Columbiaville.

3. Sagittaria L.

1. Leaf blades broad or narrow, sagittate with two basal lobes, very rarely some of the leaves unlobed; fertile heads pedicelled, *2*

2. Beak of achene conspicuous, sharply turned to the side *S. latifolia*
2. Beak a tiny erect point from a notch at 1 corner of the summit of the achene *S. cuneata*

1. Leaf blades lanceolate-oval to linear, unlobed (if rarely lobed, the fertile heads sessile), *3*
3. Fertile heads sessile or essentially so *S. rigida*
3. Fertile heads pedicelled, *4*
4. Pedicels of fertile heads stout, reflexed in fruit *S. subulata*
4. Pedicels of fertile heads slender, not reflexed, *5*
5. Anther suborbicular, with broad connective, larger than the filament; leaves very slender, almost grasslike, usually bladeless *S. Eatoni*
5. Anther broad-elliptic, the connective narrower than the cells, the anther about equal to or shorter than the filament; leaves usually long-petioled with narrow blade *S. graminea*

S. latifolia Willd. Broad-leaved arrowhead. Wet places; common. Our commonest *Sagittaria,* and exceedingly variable as to width of leaves.

S. cuneata Sheldon. Arrowhead. Muddy borders of small ponds which dry up in summer. Known from No Bottom Pond, *1955*, and from a boggy depression 1 mile north of Canaan, *1271.*

S. rigida Pursh. Tidal mud along the Hudson River, where abundant. Unknown elsewhere. Columbiaville, *3713;* South Bay, Hudson, *House 20510;* Crugers' Island, *2910.*

S. Eatoni J. G. Sm. Tidal mud along the Hudson River; otherwise unknown. Stuyvesant, *Muenscher & Clausen 4302;* Nutten Hook, *idem 4305* (CU); mud flats between Hudson and Athens, *idem 4303* (CU). Also reported by Muenscher (1937, p. 239) from Stockport Creek and Rogers Island. The estuarine plant referred to this species seems quite distinct from *S. graminea* of upland ponds in its very slender bladeless leaves and its globose anthers with broad connectives between the cells.

S. graminea Michx. Shallow water, borders of ponds; not often collected. Kinderhook Lake, *Brown 98;* No Bottom Pond, *1960;* reported by Muenscher (1935, pp. 232, 234) from Snyder, Crystal, Glass, Crooked, Nassau, Burden and Tackawasick Lakes, Rensselaer County, and from Kinderhook and Copake Lakes in Columbia County.

S. subulata (L.) Buchenau. Tidal mud along the Hudson River, where abundant. Otherwise unknown. Poelsburg, Columbiaville, Hudson, Rogers Island and Crugers' Island (figure 8).

HYDROCHARITACEAE (Frog's-bit Family)

1. Stem elongated, submerged, leafy, the leaves whorled and not over 1 to 3 cm. long **1. Anacharis**
1. Stem apparently none, the submerged ribbonlike leaves from the base of the plant, their length 30 to 200 cm. **2. Vallisneria**

1. Anacharis Richard

1. Leaves 2 mm. wide (average); staminate flower remaining attached to the plant by a long threadlike peduncle; anthers slightly more than 2 mm. long *A. canadensis*
1. Leaves averaging about 1.3 mm. wide; staminate flower sessile, breaking free and rising to the surface at flowering time; anthers about 1 mm. long. *A. Nuttallii*

A. canadensis (Michx.) Planch. (*Elodea canadensis* of *Gray's Manual*). Waterweed. Lakes and streams; common. Taghkanic Lake, *2010;* Spring Lake,

2754; Roeliff Jansen Kill at Silvernails, *1088;* Columbiaville, mouth of Stockport Creek, *Muenscher & Clausen 4338* (CU). Also reported by Muenscher (1935, p. 232) from Snyder, Crystal, Glass, Crooked, Burden, Nassau and Tackawasick Lakes in Rensselaer County, and from Kinderhook, Queechy and Copake Lakes in Columbia County.

A. Nuttallii Planch. *(Elodea Nuttallii* of *Gray's Manual).* Shallow water, tidal flats along the Hudson River. Mouth of Stockport Creek, *Muenscher & Clausen 4341* (CU) ; mouth of Stony Creek, town of Red Hook, according to Svenson (1935).

2. **Vallisneria** L.

V. americana Michx. "Eelgrass." Common in tidewater along the Hudson River; elsewhere locally abundant in lakes and streams. Stuyvesant, *House 13314;* 1 mile south of Tivoli, *2794;* Forest Lake, *2077;* reported from Queechy, Kinderhook and Copake Lakes in Columbia County, and Snyder, Crystal, Glass, Crooked, Burden, Nassau and Tackawasick Lakes in Rensselaer County (Muenscher, 1935, p. 232).

GRAMINEAE (Grass Family)

1. Spikelets 1- to many-flowered, when 2-flowered the lower floret not sterile and not of a different texture from the upper floret; internodes usually present between the florets; rachilla usually articulated above the glumes (several exceptions), *2*
- *2.* Spikelets borne in 2 rows in narrow spikelike racemes, *3*
  - *3.* Rows of spikelets on opposite sides of the rachis — Tribe *Hordeae*
  - *3.* Rows of spikelets on one side of the rachis, the spikes thus 1-sided — Tribe *Chlorideae*
- *2.* Spikelets in open or spikelike panicles, rarely in racemes, *4*
  - *4.* Spikelets 2- to many-flowered, *5*
    - *5.* Glumes as long as the lowest floret, usually as long as the spikelets; lemmas awned from the back or occasionally awnless — Tribe *Aveneae*
    - *5.* Glumes shorter than the first floret; lemmas awnless or awned from the tip or from a bifid apex — Tribe *Festuceae*
  - *4.* Spikelets with but 1 fertile flower, *6*
    - *6.* Spikelets bisexual, all alike, *7*
      - *7.* Spikelets with 2 sterile or rudimentary lemmas unlike and below the fertile lemma — Tribe *Phalarideae*
      - *7.* Spikelets without sterile lemmas below the perfect flowers, *8*
        - *8.* Lemma and palea about equal, both keeled; glumes very small or wanting; spikelets articulate below the glumes — Tribe *Oryzeae*
        - *8.* Palea usually smaller than the lemma and inclosed in it; spikelets articulate above the glumes (or, if below the glumes, at least 1 glume well-developed) — Tribe *Agrostideae*
    - *6.* Spikelets unisexual, the pistillate ones at summit of panicle — Tribe *Zizanieae*

1. Spikelets 2-flowered, the upper floret perfect, the lower one sterile and often of a different texture; internodes between the florets usually undeveloped; rachilla articulated below the glumes, *9*
- *9.* Glumes membranaceous, the sterile lemma like the glumes in texture; fertile lemma and palea indurate or at least firmer than the glumes — Tribe *Paniceae*
- *9.* Glumes indurate; sterile and fertile lemmas and palea hyaline or membranaceous, more or less alike in texture — Tribe *Andropogoneae*

Tribe 1. FESTUCEAE

1. Tall stout reeds, 1.5 to 4.0 m. tall, with large plumelike panicles; rachilla with silky hairs as long as the lemmas **7. Phragmites**
1. Plants smaller, rarely more than 1.5 m. high; rachilla naked or short-pilose, *2*
2. Lemmas 3-nerved, the nerves prominent, *3*
3. Lemmas pubescent on the nerves **9. Triplasis**
3. Lemmas not pubescent on the nerves **5. Eragrostis**
2. Lemmas 5- to many-nerved, the nerves sometimes obscure, *4*
4. Callus of florets bearded; lemmas bifid at summit, awned **8. Schizachne**
4. Callus not bearded (lemmas cobwebby at base in *Poa*), *5*
5. Lemmas keeled on the back, *6*
6. Spikelets strongly compressed, crowded in 1-sided clusters at the ends of the stiff, naked panicle branches **6. Dactylis**
6. Spikelets not strongly compressed, not crowded in 1-sided clusters, *7*
7. Lemmas awned from a minutely bifid apex **1. Bromus**
7. Lemmas awnless **4. Poa**
5. Lemmas rounded on the back (slightly keeled toward summit in *Festuca* and *Bromus*), *8*
8. Nerves of lemma prominent, parallel, not converging at summit or but slightly so **3. Glyceria**
8. Nerves of lemmas converging toward summit, the lemmas narrowed at apex, *9*
9. Lemmas awned from a minutely bifid apex **1. Bromus**
9. Lemmas awnless or awned from the tip **2. Festuca**

Tribe 2. HORDEAE

1. Spikelets solitary at each node of the rachis, *2*
2. Spikelets placed edgewise to the rachis; glume adjacent to the rachis wanting **14. Lolium**
2. Spikelets placed flatwise to the rachis; both glumes present **10. Agropyron**
1. Spikelets 2 or 3 at each joint of the rachis, *3*
3. Spikelets 3 at each node, 1-flowered **13. Hordeum**
3. Spikelets 2 at each node, 2- to 6-flowered, *4*
4. Glumes wanting or reduced to 2 short bristles; spikelets spreading horizontally at maturity **12. Hystrix**
4. Glumes usually equaling the florets; spikelets appressed or ascending **11. Elymus**

Tribe 3. AVENEAE

1. Articulation below the glumes, the spikelets falling entire, *2*
2. Lemmas, at least the upper, with a conspicuous bent awn; glumes nearly alike **16. Trisetum**
2. Lemmas awnless or the upper with a short awn; second glume much wider than the first **15. Sphenopholis**
1. Articulation above the glumes, the spikelet separating from them at maturity, *3*
3. Awns of lemmas dorsal or wanting, *4*
4. Spikelets 7 to 8 mm. long **18. Arrhenatherum**
4. Spikelets 4 to 5 mm. long **17. Deschampsia**
3. Awn of lemma from between two apical teeth **19. Danthonia**

Tribe 4. AGROSTIDEAE

1. Articulation below the glumes, the spikelets falling entire, *2*
2. Panicle dense, spikelike; lemma awned below the middle 23. **Alopecurus**
2. Panicle open, drooping; lemma with a minute awn just below the apex 22. **Cinna**
1. Articulation of spikelets above the glumes, *3*
3. Lemma indurated in fruit, much thicker and firmer than the glumes, *4*
4. Fruit awnless, dorsally compressed 28. **Milium**
4. Fruit awned, the awn sometimes deciduous, *5*
5. Awn trifid 30. **Aristida**
5. Awn simple 29. **Oryzopsis**
3. Lemmas not indurated, as thin or thinner than the glumes, *6*
6. Rootstocks short, often branched, very scaly and knotty, *7*
7. Rachilla prolonged beyond the palea; culms not branching above; leaves very broad, lanceolate 27. **Brachyelytrum**
7. Rachilla not prolonged beyond the palea; culms usually branching above; leaves elongated 25. **Muhlenbergia**
6. Rootstocks not densely scaly and knotty, *8*
8. Glumes much compressed, keeled; lemma awnless, inflorescence a dense, compact, narrow spike 24. **Phleum**
8. Glumes only slightly compressed, not keeled; inflorescence not as above, *9*
9. Callus of the floret long-haired; rachilla prolonged beyond the palea 20. **Calamagrostis**
9. Callus glabrous; rachilla not prolonged, *10*
10. Lemma 3-nerved, obtuse, shorter than the glumes 21. **Agrostis**
10. Lemma acute, 1-nerved, equaling or exceeding the glumes 26. **Sporobolus**

Tribe 5. CHLORIDEAE

1. Spikes spreading or reflexed; spikelets with one or more modified florets above the perfect one 32. **Bouteloua**
1. Spikes erect or nearly so; spikelets without additional modified florets 31. **Spartina**

Tribe 6. PHALARIDEAE

1. Spikelets green or yellowish, *2*
2. Lower florets reduced to small awnless scalelike lemmas; spikelets much compressed laterally 35. **Phalaris**
2. Lower florets consisting of awned hairy sterile lemmas exceeding the fertile florets; spikelets subterete 34. **Anthoxanthum**
1. Spikelets brown and shining 33. **Hierochloë**

Tribe 7. ORYZEAE

A single genus 36. **Leersia**

Tribe 8. ZIZANIEAE

A single genus 37. **Zizania**

Tribe 9. PANICEAE

1. Spikelets surrounded by an indurated or bristly involucre, *2*
2. Involucre of bristles 41. **Setaria**
2. Involucre burlike, the prickles retrorsely barbed 42. **Cenchrus**

1. Spikelets not surrounded by an involucre, *3*
  3. Second lemma papery, flexible, with hyaline flat margins; inflorescence with digitate spikelike branches — 38. **Digitaria**
  3. Second lemma thicker, rigid, with firm inrolled margins, *4*
    4. Branches of the inflorescence more or less 1-sided and spikelike; spikelets awned or short-pointed — 40. **Echinochloa**
    4. Branches of the inflorescence not 1-sided and scarcely ever spikelike; spikelets not awned — 39. **Panicum**

Tribe 10. ANDROPOGONEAE

1. Inflorescence of spikelike parts — 43. **Andropogon**
1. Inflorescence an open panicle — 44. **Sorghastrum**

1. **Bromus** L. Brome Grass

1. Creeping rootstocks present; lemma mostly 10 to 12 mm. long, mostly awnless — *B. inermis*
1. Creeping rootstocks absent; lemma 7 to 10 mm. long, or if longer, with a conspicuous awn, *2*
  2. Awn of lemma longer than the body, 12 to 14 mm. long; plants villous-pubescent, often purplish — *B. tectorum*
  2. Awn of lemma not longer than the body, *3*
    3. Lemma broadly elliptical, glabrous or scabrous; plants annual — *B. secalinus*
    3. Lemma lanceolate to elliptical, pubescent at least near the margin; plants perennial, *4*
      4. Lemma pubescent along the margin and the lower part of the back, the upper part glabrous; lower glume 1-nerved — *B. ciliatus*
      4. Lemma pubescent rather evenly over the back, *5*
        5. Lower glume 3-nerved; spikelets very velvety all over — *B. Kalmii*
        5. Lower glume 1-nerved, *6*
          6. Sheaths shorter than the internodes; nodes 4 to 6 in number; anthers 3 to 4 mm. long — *B. pubescens*
          6. Sheaths longer than the internodes, the 10 to 20 nodes consequently included; anthers about 2.5 mm. long — *B. purgans*

B. inermis Leyss. Known to me only from a meadow north of Bachus Pond, Malden Bridge, *3170;* [Lebanon Springs, *A. K. Harrison* in 1890 (US)].

B. ciliatus L. Swampy meadows, rather frequent. Abundant in calcareous marshes, as in the Harlem Valley. Lebanon Springs, *Harrison* (US); Boston Corners, *1666;* south of Mount Riga Station, *3362;* 2 miles east of Kinderhook, *1481;* [No Bottom Pond, *4532*].

B. pubescens Muhl. (*B. purgans* of *Gray's Manual*). Woods; usually in rocky calcareous situations; frequent.

B. purgans L. (*B. latiglumis* of *Gray's Manual*). Moist woods and along streams; known only in the Hudson Valley. Kinderhook, along Kinderhook Creek, *2089;* Stuyvesant, *House 13309;* Columbiaville, *3725;* New Forge, along Taghkanic Creek, *3486;* [Canaan, *Leggett* in 1857 (NY)].

B. Kalmii Gray. Cool swampy or rocky woods, infrequent. Kinderhook Lake, *House 15976;* bog west of Post Road School, Kinderhook, *1569;* 1.5 miles south of Ancramdale, *3380*; Stissing Mountain, *2846*; Brace Mountain, *House 24851*.

B. secalinus L. Cultivated fields, meadows and roadsides; infrequent. 3 miles south of Kinderhook, *1222;* 3 miles south of Claverack, *1237*.

B. tectorum L. Roadsides and along railroads, infrequent. Locally abundant. Nassau, *E. P. Felt;* Stuyvesant, *932;* Silvernails, *1085*.

2. **Festuca** L.

1. Plants wiry, often low; leaves mostly basal, filiform; awns usually present, *2*
  2. Basal sheaths reddish brown, thin, breaking into coarse fibers *F. rubra*
  2. Basal sheaths white to pale purplish or drab brown, firm *F. ovina*
1. Plants tall and leafy, with broad and flat leaves; awns wanting, *3*
  3. Spikelets 9 to 25 mm. long, usually 6- to 8-flowered; panicle branches very short *F. elatior*
  3. Spikelets 5 to 7 mm. long, 3- to 5-flowered; panicle branches very long, spreading *F. obtusa*

F. elatior L. Fescue grass. Woods, fields and roadsides; rather frequent.

F. obtusa Biehler. Rocky woods; common. Abundant, especially in calcareous regions. Brainard, Austerlitz, Green River, Mount Fray (Copake), Kinderhook, Nutten Hook, Claverack, banks of Hudson east of Rogers Island.

F. rubra L. Dry fields and roadsides; locally very abundant. 4 miles north of Nassau, *House 22760;* 1 mile south of Rayville, *1059;* Blue Hill, *House 22686;* Rogers Island, *2574.*

F. ovina L. Introduced from Europe. Near Kinderhook Lake, *874* (originally determined as *F. rubra*), *House 19601.* Determinations of this species by House.

3. **Glyceria** R. Br.

1. Spikelets linear, nearly terete, usually 1 cm. long or more, *2*
  2. Lemma acute, much exceeded by the palea *G. acutiflora*
  2. Lemma obtuse, equaling the palea or nearly so, *3*
    3. Spikelets slender-pedicelled; lemma glabrous between the nerves *G. borealis*
    3. Spikelets sessile or essentially so; lemma hispidulous between the nerves as well as on them *G. septentrionalis*
1. Spikelets ovate or oblong, more or less flattened, 5 to 7 mm. long or less, *4*
  4. Panicle contracted, linear, nodding, 15 to 30 cm. long *G. melicaria*
  4. Panicle open, lax, *5*
    5. Spikelets ovate, 3 to 4 mm. wide; lemma obscurely nerved *G. canadensis*
    5. Spikelets not over 2.5 mm. wide; nerves of lemma prominent, *6*
      6. Second glume 1 mm. long; spikelets short, 3 to 4 mm. long *G. striata*
      6. Second glume 2 to 2.5 mm. long; spikelets 4 to 7 mm. long, *7*
        7. Culms erect, usually stout; panicle 15 to 40 cm. long *G. grandis*
        7. Culms slender, lax, ascending from a decumbent rooting base; panicle 5 to 15 cm. long, *8*
          8. Leaf blades 4 to 8 mm. wide; anthers 1 mm. long *G. pallida*
          8. Leaf blades 1 to 3 mm. wide; anthers 0.2 to 0.5 mm. long *G. Fernaldii*

G. acutiflora Torr. Manna grass. Borders of small ponds and springs; infrequent, locally abundant. No Bottom Pond, *1339;* West Ghent, *1115* (PENN); 2 miles south of Ghent, *4014;* Pine Plains, *Peck.*

G. borealis (Nash) Batchelder. Borders of ponds and in swampy places; infrequent. Kinderhook Lake, *House 19614;* 3 miles south of Kinderhook, *1221;* pond 1 mile south of Taghkanic Lake, *House 20517;* Spring Lake, *2757;* [Brainard, *House 21530*].

G. septentrionalis Hitchc. Known only from swampy woods near Fowlers' Lake, *1675.*

G. melicaria (Michx.) F. T. Hubbard. Moist places, common. Austerlitz, Canticoke Swamp, Niverville, Pine Plains, Stephentown Center.

G. canadensis (Michx.) Trin. Rattlesnake grass. Swamps and borders of ponds, frequent. New Britain, *3636;* Brainard, *House 21528;* North Chatham, *House 20476;* Kinderhook Lake, *House 15540;* Merwins' Lake, *1243;* 2 miles east of Elizaville, 3201; 3 miles north of Ancramdale, *3584.*

G. striata (Lam.) Hitchc. Wet places, common.

G. grandis S. Wats. Swampy places, common. North Chatham, Malden Bridge, Kinderhook, Forest Lake, 1 mile south of Taghkanic Lake.

G. pallida (Torr.) Trin. Moist places in swamps and along streams, sometimes in water; frequent. Brainard, *House 21530;* 1 mile northwest of Niverville, *1009;* Kinderhook, *1376;* Blue Stores, *3210;* New Forge, *3487;* Stissing Mountain, *Peck.* Specimens from our area referred to the more northern *G. Fernaldii* seem to be mostly narrow-leaved extremes of this species.

G. Fernaldii (Hitchc.) St. John. Muddy shores of No Bottom Pond, *4533.* Otherwise unknown.

4. Poa L.

1. Plants annual, small, 5 to 20 cm. high — *P. annua*
1. Plants perennial, *2*
  2. Culms and sheaths compressed, 2-edged; rootstocks extensively creeping; plant blue-green, with narrow panicle. — *P. compressa*
  2. Culms and sheaths hardly if at all compressed, terete or nearly so; creeping rootstocks, if any, not extensive, *3*
    3. Branches of the panicle in 2's, lemma glabrous, the intermediate nerves very distinct; anthers yellow — *P. saltuensis*
    3. Branches of the panicle mostly in whorls of 4 or 5, *4*
      4. Marginal nerves of the lemma glabrous, the keel hairy, *5*
        5. Lemma prominently nerved; sheaths scabrous; ligule 4 to 6 mm. long — *P. trivialis*
        5. Lemma obscurely nerved; sheaths smooth; ligule 1 mm. long or less — *P. alsodes*
      4. Marginal nerves and also the keel of the lemma hairy, *6*
        6. Intermediate nerves of the lemma prominent; ligule 2 mm. long or less; creeping rootstocks present, usually inconspicuous — *P. pratensis*
        6. Intermediate nerves obscure; creeping rootstocks none, *7*
          7. Ligule 0.5 mm. long; glume narrow, acuminate, about as long as the first lemma — *P. nemoralis*
          7. Ligule 3 to 5 mm. long on the main culm; glume lanceolate, acute, shorter than the first lemma — *P. palustris*

P. annua L. Lawns and cultivated grounds; common.

P. compressa L. "Canada blue grass." Woods, meadows and fields; common.

P. pratensis L. Kentucky blue grass. Fields, meadows, and in woods; common.

P. trivialis L. Meadows; apparently infrequent. Bachus Pond, *926;* 1 mile north of Kinderhook, *795.*

P. alsodes Gray. Rocky woods; rather frequent eastward at higher elevations, but apparently rare in the Hudson Valley. New Lebanon, *House 21297;* 2 miles east of Austerlitz, *691a;* Bashbish Falls, *Knowlton & Schweinfurth* (CU); North Chatham, *House 21327;* [Canticoke Swamp, *House 27694*].

P. saltuensis Fern. & Wieg. Rocky woods; known only from the eastern tier of towns, at elevations of 300 m. or more. Mount Lebanon, *House 16138;* 2 miles east of Austerlitz, *691, 695;* Bashbish Brook, *Knowlton & Schweinfurth* (NEBC).

P. nemoralis L. Known only from shale rocks at Nutten Hook, *846.*

P. palustris L. Meadows and moist grounds; common. Austerlitz, Mount Fray (PENN), 2 miles south of Copake Lake (PENN), Pine Plains, Riders Mills, Germantown, Kinderhook.

5. **Eragrostis** Beauv. Lovegrass

1. Plants creeping, rooting at the nodes, forming mats — *E. hypnoides*
1. Plants erect or decumbent at base, not creeping nor mat-forming, *2*
  2. Spikelets mostly less than 5-flowered, *3*
    3. Panicles two-thirds the entire length of the plant or more, 15 to 40 cm. long; pedicels mostly 7 to 40 mm. long — *E. capillaris*
    3. Panicles usually less than half the height of the plant, 5 to 12 cm. long; pedicels mostly 2 to 6 mm. long — *E. Frankii*
  2. Spikelets mostly more than 5-flowered, *4*
    4. Plants with minute glandular depressions on the branches and on the keels of the lemmas, *5*
      5. Spikelets 2.5 to 3 mm. wide; anthers 0.5 mm. long — *E. cilianensis*
      5. Spikelets about 1.5 mm. wide; anthers 0.2 mm. long — *E. poaeoides*
    4. Plants not glandular on branches nor on lemmas, *6*
      6. Plants annual; panicle scarcely half the height of the plant, greenish to lead-colored or nearly black, *7*
        7. Summit of sheaths with soft pilose hairs; panicle branches naked at base — *E. pectinacea*
        7. Summit of sheaths without soft pilose hairs; panicle branches spikelet-bearing to near base — *E. multicaulis*
      6. Plants perennial; panicle two-thirds the height of the plant, usually bright purple — *E. spectabilis*

E. hypnoides (Lam.) BSP. Dry sandy places; rare. No Bottom Pond, *4527;* Kinderhook Lake, *House 13421;* Kinderhook Creek, Kinderhook, *4016;* Nutten Hook, *4508.*

E. capillaris (L.) Nees. Dry sandy or shaly hillsides; rather frequent. Nutten Hook, *2214;* Blue Hill, *2179.*

E. Frankii C. A. Mey. Stuyvesant, *House 13318.* Otherwise unknown.

E. pectinacea (Michx.) Nees. Waste grounds and moist soil; common. Often found in old and little-used roads, where little else can grow. Very abundant along the Hudson River on dredged-up sand.

[**E. multicaulis** Steud. 3 miles north of Canaan, *2137.* Determination of this specimen by J. R. Swallen, according to House.]

E. poaeoides Beauv. Dry soil along railroads; infrequent, but locally abundant. [Poelsburg, *3798*]; north of Stuyvesant, *1821;* railroad yards, Hudson, *4754* (USNA).

E. cilianensis (All.) Lutati *(E. megastachya* of *Gray's Manual).* Sandy dooryards, Kinderhook, *1791.* Otherwise unknown.

E. spectabilis (Pursh) Steud. Dry soil; infrequent. 1 mile north of Kinderhook, *2082.*

6. **Dactylis** L.

D. glomerata L. Orchard grass. Fields, meadows and waste places; common.

7. **Phragmites** Trin.

P. communis Trin. Reed grass. Calcareous marshes; rare. 3 miles north of Ancramdale, west of Crogan Hill, *3899;* Ghent, about 1 mile southeast of

Fowlers' Lake, *1435*. Represented in our area only by var. **Berlandieri** (Fourn.) Fern.

8. **Schizachne** Hack.

S. **purpurascens** (Torr.) Swallen. Purple oat grass. Rocky calcareous woods in the towns of Canaan and New Lebanon; locally abundant. South of New Lebanon, *738;* Douglas Knob, *4278;* 1 mile east of Canaan, *4270.*

9. **Triplasis** Beauv.

T. **purpurea** (Walt.) Chapm. Sand grass. Abundant along the Hudson River on dredged-up sand; otherwise unknown. South of Stuyvesant, *4035;* Nutten Hook, *Muenscher 4603* (CU) (figure 9).

10. **Agropyron** Gaertn.

1. Plants with extensively creeping rhizomes; spikelets at maturity dropping intact from the rachis, the individual florets not readily separating; anthers 3 to 6 mm. long, at least half as long as the lemma; a common weed of cultivation *A. repens*

1. Plants in small tufts, without creeping rootstocks; individual florets easily disarticulating at maturity; anthers 1 to 2.5 mm. long, at most one-third as long as the lemma *A. subsecundum*

A. **repens** (L.) Beauv. Quack grass. Waste and cultivated ground; common.

A. **subsecundum** (Link) Hitchc. (*A. trachycaulum* var. *glaucum* of *Gray's Manual*). Dry rocky woods and knolls; rather frequent. Stephentown Center, *House 21677;* Curtis Mountain, *House 21484;* Douglas Knob, Canaan, *3627;* 2 miles east of Elizaville, *3197;* 1 mile east of Pulvers, Ghent, *1496;* 3 miles north of Claverack, *1304;* Stissing Mountain, *2844* (PENN).

11. **Elymus** L. Wild rye

1. Awns, when mature and dry, straight and not conspicuously curved outward; palea 5 to 8 mm. long, *2*

2. Glumes broad, 0.9 to 2 mm. wide, strongly indurated and more or less curved at base, *3*

3. Glumes, including the awns, 1 to 2.7 cm. long; lemmas 1 to 3 cm. long, *4*

4. Lemmas and glumes glabrous or merely scabrous-ciliate *E. virginicus*

4. Lemmas and glumes villous-hirsute *E. virginicus* f. *hirsutiglumis*

3. Glumes, including awns, 2.7 to 4 cm. long; lemmas mostly 3.5 to 4.5 cm. long *E. virginicus* var. *glabriflorus*

2. Glumes narrow, 0.4 to 0.8 mm. wide, often subulate to subsetaceous, indurated and terete below, practically straight, *5*

5. Leaf blades and sheaths villous; lemma villous *E. villosus*

5. Leaf blades and sheaths not hairy; lemma scabrous or glabrous *E. riparius*

1. Awns, when mature and dry, curved outward noticeably toward the apex; palea 9 to 11 (15) mm. long; lemmas villous-hirsute, *6*

6. Leaves very broad, 13 to 20 mm. wide; spike slender and very loose, pendent from the base; glumes mostly 15 to 20 mm. long; leaves commonly evidently hairy on veins above *E. Wiegandii*

6. Leaves 5 to 15 mm. wide; spike somewhat dense, arching; glumes mostly 20 to 25 mm. long; leaves glabrous or somewhat scabrous above *E. canadensis*

E. **villosus** Muhl. Dry banks and along streams; apparently infrequent in the Hudson Valley. Unknown elsewhere. Kinderhook, along Kinderhook Creek, *1362;* Mount Merino, *1105;* 1.5 miles southeast of Clermont, along Roeliff Jansen Kill, *3233.*

E. **canadensis** L. Dry shaly banks; rather frequent in the Hudson Valley; unknown elsewhere. Poelsburg, *1824;* Stuyvesant Falls, *2038;* 2 miles east of Germantown, *2924;* south of Tivoli, *2793.*

E. **Wiegandii** Fern. This seems in our area to be a well-marked species growing in shaded alluvial soil; Kinderhook, along Kinderhook Creek, *2087;* Valatie, east of village, along Kinderhook Creek, *1892.*

E. **riparius** Wieg. Margins of streams and ponds, moist meadows and thickets; frequent. Mount Lebanon, *House 15602;* Brainard, *House 21927;* 2 miles northeast of Chatham, *1756;* Kinderhook Lake, House *13397;* Stuyvesant, along Mill Creek, *1815;* 2 miles east of Germantown, *2926;* Cheviot, *2830a.*

E. **virginicus** L. Moist soils, often along streams; common. New Lebanon; Brainard; Kinderhook Lake; Robinson Pond; Kinderhook; Hudson; mouth of Roeliff Jansen Kill, Germantown; Madalin. A variable species, represented with us also by what appear to be the following extremes:

Var. **glabriflorus** (Vasey) Bush. Copake Falls, *Britton et al.* (NY; det. by Agnes Chase as *E. australis* var. *glabriflorus*).

Forma **hirsutiglumis** (Scribn.) Fern. Widely distributed, but apparently less frequent than the species. Brainard, *House 21925;* Stuyvesant Falls, *2037;* 2 miles east of Germantown, *2928;* Cheviot, *2830.*

12. Hystrix Moench

H. **patula** Moench. Bottle-brush grass. Woods; common.

13. Hordeum L.

H. **jubatum** L. Adventive in railroad yards at Hudson, where abundant, *4757* (USNA). Otherwise unknown.

14. Lolium L. Darnel

L. **perenne** L. Cultivated ground east of Blue Hill, *House 22703* [now identified by House as *L. multiflorum* Lam.]. Otherwise unknown.

15. Sphenopholis Scribn.

1. Panicle dense, spikelike, erect or nearly so; second glume very broad, slightly cucullate, somewhat inflated at maturity *S. obtusata*
1. Panicle lax, nodding, few- to many-flowered, but not spikelike, *2*
  2. Panicle dense, many-flowered; second glume acute or subacute; lemma smooth, not scabrous *S. intermedia*
  2. Panicle loose, relatively few-flowered; second glume broadly rounded at tip; lemma scabrous on back *S. nitida*

S. **obtusata** (Michx.) Scribn. Dry soil; rare or local. Reported from Pine Plains by Hoysradt (1875-79); Little Stissing Mountain, *Peck;* Blue Hill, *House 22677.*

S. **intermedia (Rydb.)** Rydb. Moist places meadows and rocky woods; frequent. Washburn Mountain, *3461;* Pine Plains, *Peck;* Brainard, *House 21539;* Kinderhook, *2525;* Kinderhook Lake, *House 21435;* Hotaling Island, *3147.*

S. nitida (Biehler) Scribn. Dry wooded hillsides; rare or local. Rocky calcareous woods, Croghan Hill, *822;* Blue Hill, House *22677a;* New Forge, *4385;* pond 1 mile south of Taghkanic Lake, *4376.*

16. **Trisetum** Pers.

T. spicatum (L.) Richter. Known only from dry shale outcrops on an island at Stuyvesant Falls, *992.*

17. **Deschampsia** Beauv. Hair grass

1. Leaf blades filiform, flexuous; awn of lemma exserted, bent abruptly about the middle *D. flexuosa*

1. Leaf blades flat, stiff; awn included or very slightly exserted, nearly straight *D. caespitosa*

D. flexuosa (L.) Trin. Dry rocky woods and slopes, frequent. Austerlitz; Mount Fray; Nutten Hook; Rogers Island.

D. caespitosa (L.) Beauv. Dry shaly slopes at Nutten Hook, *847, 852;* breakwater pilings, Hotaling Island, *3142.* Otherwise unknown.

18. **Arrhenatherum** Beauv.

A. elatius (L.) Presl. Tall oat grass. Meadows and roadsides; locally abundant. Malden Bridge, *908;* north of Kinderhook, *950.*

19. **Danthonia** DC. Oat grass

1. Leaves mostly basal, short, forming a curly mass when dry; leaf blades rarely more than 15 cm. long; panicle 2 to 5 cm. long, open only at anthesis; awn of the lemma with several tight twists when dry. *D. spicata*

1. Leaves in part cauline, stiffer and not curly; blades often 20 to 25 cm. long; panicle 5 to 8 cm. long; awn of the lemma loosely 2- to 3-curled when dry *D. compressa*

D. spicata (L.) Beauv. Dry sandy or rocky fields and woods; common. Green River; Mount Fray, Copake; Fox Hill, Ancram; Kinderhook Lake; Mount Merino, *1104* (PH, PENN); Rogers Island.

D. compressa Aust. Moist rocky woods; locally very abundant eastward, at elevations of 300 m. or more; otherwise unknown. No Bottom Pond, *1345, 3503;* Green River, *1534, 3522;* reported by Hoysradt (1875-79) from Mount Riga and near Mount Everett.

20. **Calamagrostis** Adans.

1. Awn of the lemma abruptly bent, protruding sidewise from the glumes; callus-hairs sparse, ½ to ¾ as long as the lemma; palea ¾ as long as lemma *C. perplexa*

1. Awn straight, included; callus-hairs copious, about as long as the lemma *C. canadensis*

C. perplexa Scribn. In our area known only from rocky (schist) slopes of Mount Fray, Copake, at an elevation of about 500 m., *2649* (PENN).

C. canadensis (Michx.) Beauv. Moist grounds and swamps; common.

21. Agrostis L. Bent grass

1. Palea evident, 2-nerved, at least half as long as the lemma, *2*
  2. Ligule of the upper leaves 0.5 to 2.0 mm. long; leaf blades 1.5 to 2.8 mm. wide *A. tenuis*
  2. Ligule of the upper leaves 2 to 6 mm. long; leaf blades 3 to 8 mm. wide *A. alba*

1. Palea obsolete or a minute nerveless scale much shorter than the lemma, *3*
  3. Branches of panicle branched toward the ends; spikelets apparently clustered toward the tips of the branchlets *A. hyemalis*
  3. Branches of panicle branched at or below the middle; spikelets scattered *A. perennans*

A. alba L. Redtop. Meadows, pastures and woodlands; common. Stissing Mountain, *Peck;* North Chatham, *1155;* Waldorf Pond, *House 21432*; Kinderhook, *1093.*

A. tenuis Sibth. Colonial bent. Hayfields, Kinderhook, *1206.*

A. hyemalis (Walt.) BSP. Ticklegrass. Dry fields and woodlands; common. Stephentown, *Whitney 3970;* 2 miles south-southwest of Hillsdale, *3551;* Copake Falls, *Burnham* (CU); Stissing Mountain, *2859* (PENN); 2 miles southeast of North Chatham, *1154;* Kinderhook, *1069, 1220.* Most New York State specimens may be referred to the segregate *A. scabra* Willd. as in *Gray's Manual.*

A. perennans (Walt.) Tuckerm. Autumn bent. Damp or dry fields and woodlands. No Bottom Pond, *1333;* New Forge, *3468;* Kinderhook Lake, *House 13395;* Kinderhook, *1975.*

22. Cinna L.

1. Leaves large, 8 to 20 mm. wide; spikelets 5 mm. long; panicle rather dense, with ascending branches *C. arundinacea*
1. Leaves smaller, 5 to 10 mm. wide; spikelets 3 to 4 mm. long; panicle loose, spreading or drooping *C. latifolia*

C. arundinacea L. Swampy woods and borders of ponds and streams; common. Not reported from the higher elevations eastward and northeastward. Robinson Pond; Kinderhook; Stuyvesant; 2 miles south of Claverack; Rogers Island; Cheviot; Madalin.

C. latifolia (Trev.) Griseb. Cool swamps and moist rocky woods; unknown in the Hudson Valley. Canticoke Swamp, *1738* (PENN); 2 miles south of Flatbrook, *3609;* 4 miles southeast of Spencertown, *1863.*

23. Alopecurus L.

A. aequalis Sobol. Foxtail grass. In water and muddy places; margins of springs and ponds; infrequent in the Hudson Valley, unknown elsewhere. Kinderhook Lake, *House 19613;* Kinderhook, *968;* 2 miles southeast of Stuyvesant Falls, *1390.*

24. Phleum L.

P. pratense L. Timothy. Meadows and roadsides; common.

25. Muhlenbergia Schreb.

1. Glumes minute, not more than one-fourth the length of the floret; clusters of thick scaly rootstocks none; base of slender branching culms decumbent and rooting at nodes *M. Schreberi*

1. Glumes at least half the length of the floret; plants with clusters of prominent scaly creeping rootstocks, *2*
  2. Glumes broadly ovate, acute, ½ to ⅔ as long as the floret, *3*
    3. Lemma awnless or essentially so; spikelet 1.5 to 2.5 mm. long *M. sobolifera*
    3. Lemma with an awn 2 to 5 times as long as the body; spikelets 3 to 4 mm. long *M. tenuiflora*
  2. Glumes lanceolate, acute to long-pointed, three-fourths as long as the floret or longer, *4*
    4. Glumes unawned, sometimes with an acuminate tip, but scarcely or not at all exceeding the lemmas, *5*
      5. Internodes lustrous and glabrous; plants sprawling-topheavy, with geniculate-spreading branchlets *M. frondosa*
      5. Internodes puberulent below the nodes; plants not as above, *6*
        6. Lemma terminated by an awn 5 to 10 mm. long *M. sylvatica*
        6. Lemma not awned or scarcely so (if so, the glume about equaling it) *M. mexicana*
    4. Glumes with a slender awn as long as or longer than the body, much exceeding the lemmas; panicle very dense and spikelike *M. glomerata*

M. sobolifera (Muhl.) Trin. Dry rocky woods; rather frequent. 1 mile east of Pulvers, Ghent, *2342* (PENN); Robinson Pond, *3955;* 2 miles north-northeast of Jackson Corners, *3582;* Blue Hill, *2184;* Stissing Mountain, *House 21020.*

M. tenuiflora (Willd.) BSP. Dry rocky woods; rather frequent eastward; unknown in the Hudson Valley. Green River, *1520;* Cedar Mountain, *3576;* Bashbish Falls, *Dobbin 931;* Stissing Mountain, west side, *3878;* 3 miles northwest of Ghent, *1424.*

M. glomerata (Willd.) Trin. Marshes, especially in calcareous soil, and in rocky woods; frequent eastward, but apparently rare in the Hudson Valley. Bog west of Douglas Knob; Copake Falls; 1 mile northeast of Boston Corners; 3 miles north of Ancramdale; Stissing Mountain; 1 mile southeast of Fowlers' Lake; 3 miles north of Castleton, *3980.*

M. frondosa (Poir.) Fern. Roadsides, waste ground and woods; locally abundant. Moist shaly soil in woods, 1.5 miles east of Hollowville, *3761;* gravelly flat in creek, Columbiaville, *4495;* roadside, Alvords' Dock, Stockport, *4499.*

M. sylvatica Torr. Moist woods; apparently infrequent. Brainard, *House 21930;* 2 miles east of Germantown, along Roeliff Jansen Kill, *2923.*

M. mexicana (L.) Trin. Moist woods and wet meadows; rather frequent eastward, but apparently rare in the Hudson Valley. No Bottom Pond, *1946;* 1 mile east of Austerlitz, *2285;* 2 miles south-southwest of Green River, *3526;* Pulvers Corners, *3850;* boggy meadow south of Kinderhook, *4028.*

M. Schreberi J. F. Gmel. Known only from wet grassy places at Robinson Pond, *House 20612.*

26. Sporobolus R. Br.

S. vaginiflorus (Torr.) Wood. Dry soil; frequent. Waldorf Pond, *House 20926;* 2 miles north of Chatham, *4516;* Poelsburg, *3801;* Rogers Island, *4461;* Silvernails, *2429* (PENN); Robinson Pond, *3939.*

27. Brachyelytrum Beauv.

B. erectum (Schreb.) Beauv. Moist or rocky woods; frequent. Stephentown; Austerlitz; Bashbish Gorge, according to Knowlton (1919); Stissing Mountain; Columbiaville; Tivoli; Niverville.

28. **Milium** L.

M. effusum L. Millet grass. Woods; rare. 1 mile southwest of West Ghent, *3698;* rocky wooded slope, Harvey Mountain, *Hoffmann* (NEBC).

29. **Oryzopsis** Michx. Rice grass

1. Spikelets, excluding the awns, 3 to 4 mm. long *O. pungens*
1. Spikelets, excluding the awns, 6 to 9 mm. long *2*
  2. Leaves nearly all toward base of culm, stiff, erect, long-linear, 3 to 8 mm. wide; upper leaves much reduced; flowering in early May *O. asperifolia*
  2. Leaves cauline, the basal ones reduced; blades 5 to 15 mm. wide, soft, lax; flowering in July and August *O. racemosa*

O. asperifolia Michx. Dry rocky woods; common or frequent eastward, at elevations of 300 m. and above; unknown in the Hudson Valley. Harrietta Falls (Stissing Mountain?), *Hoysradt* (NY); Canaan; Washburn Mountain; 2 miles east of Spencertown, *4199;* 2 miles southeast of Churchtown, *4179.*

O. racemosa (Sm.) Ricker. Rocky woods; common. Very abundant in calcareous regions. Austerlitz; Stissing Mountain; 3 miles north of Claverack; Fowlers Lake; Snyderville; 2 miles north of Jackson Corners; 2.5 miles west of Clermont.

[**O. pungens** (Torr.) Hitchc. Pine Plains, *Hoysradt* (NY).]

30. **Aristida** L.

A. dichotoma Michx. Poverty grass. Dry soil; common.

31. **Spartina** Schreb.

S. pectinata Link. Cord grass. Tidal mud along the Hudson River; infrequent. Unknown elsewhere. 3 miles north of Castleton, *3965;* Stuyvesant, *House 13310;* Columbiaville, *4046;* Magdalen Island, *2676.*

32. **Bouteloua** Lag.

B. curtipendula (Michx.) Torr. Grama grass. Dry shaly hillsides; rare, but locally abundant. 3 miles north of Claverack, *2193;* Mount Merino, *2305;* Blue Hill, *2166.*

33. **Hierochloë** R. Br.

H. odorata (L.) Beauv. About 4 miles east of Taborton, just within the Kinderhook Drainage, *House 30918.* This area in the northeastern part of the Kinderhook Creek Basin is the least well known botanically of any part of the Columbia County region as treated in this volume. Here at the southern edge of the Rensselaer Plateau are the southernmost outliers of the northern spruce-balsam forests, and here occur such species as the present one and *Amelanchier Bartramiana,* neither of which is known locally except through these recent collections by House.

34. **Anthoxanthum** L.

A. odoratum L. Sweet vernal grass. Meadows and roadsides; common. Old Chatham; Malden Bridge; Chatham; Kinderhook; Kinderhook Lake.

35. **Phalaris** L.

1. Leaf blades green *P. arundinacea*
1. Leaf blades white-striped *P. arundinacea* var. *picta*

P. arundinacea L. Canary grass. Swamps and creek banks; common. Malden Bridge; Chatham; Robinson Pond; 3 miles north of Ancramdale; Kinderhook; Stuyvesant Falls.
Var. **picta** L. (forma *variegata* of *Gray's Manual)*. Ribbon grass. Cultivated and locally established. Pine Plains, *Peck*.

36. **Leersia** Sw.

1. Spikelets 2.5 to 3 mm. long — *L. virginica*
1. Spikelets 4 to 5 mm. long — *L. oryzoides*

L. oryzoides (L.) Sw. Sawgrass. Wet places; common. New Britain, *3635;* Forest Lake, *2076;* Merwins' Lake, *2005* (PENN); 1 mile north of Kinderhook, *1977*.

L. virginica Willd. Wet places; with the preceding, but somewhat more common. Not reported eastward. 3 miles north of Nassau; 2.5 miles east of Chatham Center; New Forge; Hotaling Island; Stuyvesant; Kinderhook; Columbiaville; 1 mile southeast of West Ghent; Madalin.

37. **Zizania** L.

Z. aquatica L. "Wild rice." Tidal marshes along the Hudson River; there very common and often a dominant plant. Unknown elsewhere except at Tackawasick Lake, where introduced (Muenscher, 1935, p. 245). Hotaling Island, *Taylor 1359* (NY); Nutten Hook, *2222;* Hudson, *House 20501;* Tivoli, *2778*. A few specimens which have been referred to the var. *angustifolia* Hitchc. seem to be merely depauperate individuals of the typical form.

38. **Digitaria** Heist.

D. sanguinalis (L.) Scop. Crabgrass. Cultivated fields, lawns and waste places; common.

39. **Panicum** L. Panic grass

1. Plants annual, *2*
  2. Plants glabrous — *P. dichotomiflorum*
  2. Plants more or less hispid, *3*
    3. Panicle diffuse, more than half the length of the entire plant. — *P. capillare*
    3. Panicle not over one-third the length of the entire plant, *4*
      4. Blades about 1 cm. wide; culms stout — *P. Gattingeri*
      4. Blades not over 6 mm. wide; culms slender — *P. philadelphicum*
1. Plants perennial, *5*
  5. Basal leaves, if present, similar to the culm leaves, not forming a basal rosette, *6*
    6. Spikelets long-pedicelled; plants with knotty scaly rootstocks — *P. virgatum*
    6. Spikelets short-pedicelled along the main branches of the panicles; rootstocks none — *P. agrostoides*
  5. Basal leaves usually distinctly different from the culm leaves, forming a basal winter rosette, *7*
    7. Leaves elongate-linear, erect, narrow (3 mm. wide), almost 20 times as long as wide, nearly all basal; plants low and tufted, *8*
      8. Spikelets 3 to 3.5 mm. long, acute or subacuminate; plants nearly glabrous — *P. depauperatum*
      8. Spikelets 2 to 2.5 mm. long, obtuse or subobtuse, *9*

9. Sheaths pilose; spikelets pubescent *P. linearifolium*
9. Sheaths glabrous; spikelets almost glabrous *P. linearifolium* var. *Werneri*

7. Leaves linear-lanceolate or broader; if less than 5 mm. wide, not conspicuously elongate; plants usually taller and more open, not low and tufted, *10*
10. Spikelets 2.7 mm. long or more, *11*
11. Sheaths, at least the lower, strongly papillose-hispid; spikelets 2.7 to 3 mm. long *P. clandestinum*
11. Sheaths glabrous or softly villous; spikelets 3.4 to 3.7 mm. long *P. latifolium*

10. Spikelets 2.5 mm. long or less, *12*
12. Spikelets, sheaths and blades glabrous *P. dichotomum*
12. Spikelets pubescent; sheaths and blades usually at least sparsely pubescent or pilose, *13*
13. Culms and sheaths with long straight hairs; ligule 3 to 5 mm. long, *14*
14. Axis of panicle glabrous or at most with few appressed hairs; leaf blades glabrous or very sparsely pilose above, glabrous or minutely pubescent beneath; upper sheaths glabrous or nearly so *P. lanuginosum* var. *Lindheimeri*
14. Axis of panicle spreading pilose, at least on the lower internodes; leaf blades pilose to glabrous above, commonly pubescent beneath; upper sheaths mostly pilose, *15*
15. Spikelets mostly 1.6 to 2.1 mm. long; leaf blades densely or loosely short pilose or glabrous above *P. lanuginosum* var. *fasciculatum*
15. Spikelets mostly 1.3 to 1.5 mm. long; leaf blades long-pilose above, with hairs mostly 3 to 6 mm. long *P. lanuginosum* var. *implicatum*
13. Culms and sheaths crisp-puberulent; ligule 0.8 to 2 mm. long *P. tsugetorum*

P. depauperatum Muhl. Dry sandy soil; 1 mile south of Niverville, *870;* 2 miles south of Germantown, *3163;* Brace Mountain, Northeast, *4482.* Reported by Hoysradt (1875-79) from Pine Plains.

P. linearifolium Scribn. Dry woods and shaly banks and knolls; common. New Lebanon, *House 21307;* Little Stissing Mountain, *Peck;* Poelsburg, *886;* Kinderhook Lake, *901;* 1 mile southwest of West Ghent, *3296;* Mount Merino, *1101;* Blue Stores, *3205.*

Var. **Werneri** (Scribn.) Fern. With the last; frequent. Green River, *1537;* Brainard, *House 21356;* Alvords' Dock, Stockport, *764;* Blue Hill, *House 22658;* 1 mile south of Germantown, *3310.*

P. dichotomum L. Dry woodlands. 1 mile northwest of Brainard, *House 21403;* Pine Plains, *Peck;* [3 miles north of Kinderhook, *1315;* north of Brace Mountain, *House 24836*].

P. lanuginosum Ell., var. **Lindheimeri** (Nash) Fern. Known only from North Chatham, *House 20464.* I am unable to separate the various species of this group of *Panicum* according to Hitchcock's treatment, so that for the *Spreta* and *Lanuginosa* of Hitchcock I prefer to follow the interpretation of the group as stated by Fernald (Rhodora 23: 141, 223-228. 1921, 1922. Rhodora 36: 77. 1934).

Var. **implicatum** (Scribn.) Fern. Dry fields and woodlands, in sandy or rocky places; frequent eastward. Green River, in rocky woods, *1539;* New Forge, *3469.*

Var. **fasciculatum** (Torr.) Fern. Situations similar to the preceding; frequent in the Hudson and Harlem Valleys. Kinderhook Lake, *House 21433;* Kinderhook, *953;* Blue Hill, *House 22692;* 3 miles north of Ancramdale, *3340.*

P. tsugetorum Nash (included in *P. columbianum* in *Gray's Manual*). Known only from a collection made by Hoffmann at Bashbish Falls (NEBC).

P. clandestinum L. Moist sandy soil, usually along creeks; frequent in the Hudson Valley. Unknown from the higher elevations eastward. Riders Mills, *1266;* Niverville, *1144;* Columbiaville, *3711;* Rogers Island, *2568* (PENN); New Forge, *3485;* 1.5 miles southeast of Clermont, *3225.*

P. latifolium L. Dry or rocky woods; frequent. Stephentown Center, *House 21675;* Brainard, *House 21388;* North Chatham, *House 20455;* Mount Fray, Copake, *2619* (PENN); 2 miles north-northeast of Jackson Corners, *3581;* Blue Hill, *House 22679;* [north of Brace Mountain, *House 24829*].

Numerous specimens with somewhat pubescent nodes suggest, by this character, *P. Boscii* Poir.; all seem, however, to have the spikelets of *P. latifolium,* and apparently *P. Boscii* does not occur in our area.

P. dichotomiflorum Michx. Tidal flats and sandy shores along the Hudson River; there frequent or locally abundant. Nutten Hook, *4504;* Columbiaville, *4496;* between Hudson and Athens, *Muenscher & Clausen 4595* (CU); [south of Castleton, *House 24177*].

P. Gattingeri Nash. Sandy and muddy shores and roadsides, in the Hudson and Harlem Valleys, where increasingly common as a weed in disturbed soil. New Baltimore, Greene County, *House 23224;* Kinderhook Lake, *Peck* (NY); [1 mile south of Kinderhook, *4022;* near Waldorf Pond, *House 20923*].

P. philadelphicum Bernh., var. **Tuckermani** (Fern.) Steyerm. & Schmoll (*P. Tuckermani* of *Gray's Manual*). Sandy and muddy shores; rather infrequent. Kinderhook Lake, *Peck* (det. by Agnes Chase as *P. Tuckermani*); No Bottom Pond, *4529.*

P. capillare L. Witch grass. Widespread as a weed in cultivated grounds, roadsides and waste places; frequent. Gravelly flats along Stockport Creek at Columbiaville, *4498;* [Waldorf Pond, *House 23820;* Nutten Hook, *4503, 4510*; Boston Corners, House *24861;* south of Castleton, *House 24193*].

P. virgatum L. Moist or sandy soil; infrequent in the Hudson Valley; unknown elsewhere. Stuyvesant, *House,* Aug. 5, 1916; 2 miles north of Kinderhook, *1693*; Columbia-Rensselaer County line, Hudson River, *1689.*

P. agrostoides Spreng. Known only from moist gravelly-sandy shores of Kinderhook Lake, *House 13407, 19606, 21747.*

40. **Echinochloa** Beauv.

1. Leaf sheaths, at least the lower, hispid, often papillose; spikelets ellipsoid, long-awned (1 to 2 cm.) *E. Walteri*

1. Leaf sheaths glabrous; spikelets ovoid or oval, variously awned, the awn usually 5 to 10 mm. long *E. crusgalli*

E. Walteri (Pursh) Nash. Tidal marshes along the Hudson River; infrequent or rare. Near mouth of Muitzes Kill, *House 24195.*

E. crusgalli (L.) Beauv. Barnyard grass. Cultivated grounds and wet places; common. This species is found in abundance in the tidal swamps of the Hudson River, and seems unquestionably native there and in other localities. There is, however, disagreement as to the specific identity of this plant with the European *E. crusgalli* (see Fernald, Rhodora 17: 105-107, 1915 and Hitchcock, Manual Grasses of U. S. 693, *1935*)

Var. **frumentacea** (Link) Wight (*E. frumentacea* of *Gray's Manual*).

"Japanese millet." Stuyvesant, *House 13316.* A form with awnless spikelets and thick appressed incurved racemes.

41. **Setaria** Beauv.

1. Bristles below each spikelet numerous, at least more than five; panicle greenish yellow at maturity *S. lutescens*
1. Bristles below each spikelet 1 to 3; panicle green *S. viridis*

S. lutescens (Weigel) F. T. Hubb. (*S. glauca* of *Gray's Manual*). Foxtail grass. Waste and cultivated ground; common.

S. viridis (L.) Beauv. Foxtail grass. Waste and cultivated ground; infrequent or local.

42. **Cenchrus** L.

C. longispinus (Hack.) Fern. Sandbur. Rather abundant along the Hudson River on dredged-up sand; otherwise unknown. Poelsburg, *3802;* Stuyvesant, *4051;* Nutten Hook.

43. **Andropogon** L.

1. Racemes solitary *A. scoparius*
1. Racemes in fascicles of 2 to 6, on a long exserted peduncle *A. Gerardi*

A. scoparius Michx. Little bluestem. Dry fields and hillsides, often in sterile or acid soil; common. Copake Falls, *Britton et al.* (NY); Boston Corners, *2271;* Stissing Mountain, *2849;* 4 miles north of Kinderhook, *2357.*

A. Gerardi Vitman. Big bluestem. Rocky or moist soil, often near water. Infrequent, but widely distributed. Copake Falls, *Britton et al.* (NY) (det. by Nash as *A. provincialis*); Stissing Mountain, *2841;* Valatie, *3754;* Stuyvesant Falls, *2039*; Columbiaville, *4045*; [Pine Plains, *House 21042*].

44. **Sorghastrum** Nash

S. nutans (L.) Nash. Dry shaly hillsides; rare but locally abundant. South end of Mount Merino, *2432;* north of Robinson Pond, *3922.*

CYPERACEAE (Sedge Family)

1. Flowers unisexual **10. Carex**
1. Flowers perfect, *2*
  2. Spikelets several- or many-flowered, with but one (rarely more) of the lower scales empty, *3*
    3. Scales of the spikelet strictly 2-ranked, conduplicate and keeled, *4*
      4. Inflorescence terminal; flowers without perianth bristles **1. Cyperus**
      4. Inflorescence axillary; flowers furnished with bristles **7. Dulichium**
    3. Scales of the spikelet spirally imbricated in several ranks, *5*
      5. Base of the style swollen, persistent as a tubercle crowning the mature achene, *6*
        6. Spike solitary, terminating the naked culm 2. **Eleocharis**
        6. Spikelets in an involucrate umbel 3. **Bulbostylis**
      5. Base of style not as above, *7*
        7. Base of style swollen, deciduous; bristles absent 4. **Fimbristylis**
        7. Base of style not swollen; bristles usually present, *8*
          8. Bristles none to 8, included or somewhat exserted in fruit **6. Scirpus**
          8. Bristles 6 to many, silky or cottony, much elongated in fruit 5. **Eriophorum**
  2. Spikelets mostly 1- or 2-flowered, with several to many of the lower scales empty, *9*

9. Style 2-cleft; achene with a beaklike tubercle 8. **Rhynchospora**
9. Style 3-cleft; achene without a beaklike tubercle 9. **Cladium**

1. Cyperus L.

1. Style 2-cleft; achenes lenticular; spikelets strongly flattened, *2*
2. Scales of the spikelets membranous, dull; style branches exserted 2.3 to 4 mm. *C. diandrus*
2. Scales firm, subcoriaceous, shining; style branches exserted 1.5 mm. or less *C. rivularis*
1. Style 3-cleft; achenes trigonous, *3*
3. Scales tapering to slender recurved tips; plants annual, small, 2 to 20 cm. tall *C. inflexus*
3. Scales with straight tips, *4*
4. Spikelets flattened, sometimes slightly so, *5*
5. Spikelets in distinctly umbellate spikes, the umbels with 4 to 10 rays; inflorescence not a globose head, *6*
6. Scales 3.2 to 5 mm. long *C. strigosus*
6. Scales 1 to 3 mm. long, *7*
7. Scales 2 to 3 mm. long; rachis narrowly winged, not thickened; plants perennial, with slender tuber-bearing rootstocks *C. esculentus*
7. Scales 1 to 1.5 mm. long; rachis with broad wings which become separated as scales; plants annual *C. erythrorhizos*
5. Spikelets in more or less dense heads or with a few upright elongate rays, *8*
8. Spikelets mostly 8 to 15 mm. long, 11- to 15-flowered; scales roundish, mucronate, yellow-brown *C. Houghtonii*
8. Spikelets mostly 3 to 8 mm. long, 4- to 8-flowered; scales, at least the lower, blunt, greenish *C. filiculmis*
4. Spikelets terete, elongated, densely clustered in a crowded short-rayed umbel *C. odoratus*

C. diandrus Torr. Wet lakeshores; infrequent. Many references to this species in eastern New York are based on occurrences of *C. rivularis.* Kinderhook Lake, *Peck, House 13420;* Knickerbocker Lake, *1994.*

C. rivularis Kunth. Wet creek banks and marshes; common, except northeastward, where unknown. Very abundant in and characteristic of the calcareous marshes of the Harlem Valley. Brainard, *House 21926;* Copake Falls, *Britton et al.* (NY); Copake Falls, *3909;* 3 miles north of Ancramdale, *3887;* Pulvers Corners, *3843;* Valatie, *1872;* south of Kinderhook, *4019;* Nutten Hook, *Muenscher & Clausen 4368* (CU); Glenco Mills, *4032.*

C. inflexus Muhl. Moist ground along streams; infrequent in the Hudson Valley. Unknown eastward. East Nassau, *House 21935;* Kinderhook Lake, *House 13418;* 2 miles east of Valatie, *1871;* 1 mile south of Kinderhook, *4021;* Nutten Hook, *4506.*

C. Houghtonii Torr. Bashbish Falls, *Hoffmann* (NEBC). Reported from this station by Hoffmann (Proc. Boston Soc. Nat. Hist. 36:232. 1922).

C. esculentus L. "Nut grass." Moist open places, often in cultivated ground; rather frequent. Kinderhook Lake, *House 20957;* Valatie, *2389.*

C. erythrorhizos Muhl. Abundant in dredged-up sand north of Nutten Hook, *4501.* Otherwise unknown.

C. odoratus L. Sandy soil near tidewater along Hudson River; occasional, locally abundant. Nutten Hook, *4059;* flats between Hudson and Athens, *Muenscher & Clausen 4366* (CU).

C. strigosus L. Moist soil, often along streams; frequent. Not reported from the higher elevations eastward and northeastward. Chatham, *Harriet Wheeler* (CU); Niverville, *1794;* Valatie, *1489;* Kinderhook, *4020;* Rogers Island, *2951* (PENN).

C. filiculmis Vahl. Dry shaly or sandy hillsides and knolls; frequent in the Hudson Valley and adjoining uplands; not reported from the eastern tier of towns. Poelsburg; Stuyvesant Falls; Ghent; near Fowlers' Lake; Mount Merino; Blue Hill; Blue Stores; Silvernails. All Columbia County material seems to correspond to the var. **macilentus** Fern.

2. Eleocharis[1] R. Br. "Spike rush"

1. Achenes lenticular, mostly smooth and glossy; styles 2-cleft, *2*
- *2.* Upper sheaths loose, with white scarious tips; scales purple-brown, with green midribs; plants low, perennial, with slender matted rootstocks *E. olivacea*
- *2.* Upper sheaths close and firm, green, not scarious, the tips often dark-margined, *3*
  - *3.* Plants tufted, mostly annual, without conspicuous rootstocks, *4*
    - *4.* Tubercle (style-base) nearly or quite as broad as the achene; stamens 3, *5*
      - *5.* Tubercle deltoid, ⅓ to nearly ½ as high as the body of the achene; bristles much exceeding the achene *E. obtusa*
      - *5.* Tubercle very low, not more than ¼ as high as the body of the achene; bristles equaling the achene or rudimentary *E. Engelmanni*
    - *4.* Tubercle less than ⅔ as broad as the achene; stamens 2; bristles wanting or rudimentary; scales greenish or dull brown *E. ovata*
  - *3.* Plants not tufted; perennials with elongate rootstocks, *6*
    - *6.* Basal scales of the spikelet usually 2 or 3 below the thinner fertile scales; culms 0.5 to 5 mm. in diameter (in dried material) at summit of the upper sheath, *7*
      - *7.* Tubercle elongate, much longer than broad; fertile scales obtuse to subacute, the tips not conspicuously spreading *E. palustris*
      - *7.* Tubercle depressed-deltoid, as broad as or broader than long; fertile scales mostly acute to attenuate, with spreading ascending tips *E. Smallii*
    - *6.* Basal scale of the spikelet solitary, spathiform, usually completely encircling the base of the spikelet; culms filiform, 0.5 to 1.5 mm. in diameter *E. calva*

1. Achenes triangular or plumply 3-sided; styles 3-cleft, *8*
- *8.* Achenes regularly reticulate or cross-lined; culms finely capillary, dwarf, often matted *E. acicularis*
- *8.* Achenes smooth or papillose-roughened, not regularly reticulate, *9*
  - *9.* Tubercle depressed-triangular, as broad as high or broader, *10*
    - *10.* Achenes olivaceous *E. tenuis*
    - *10.* Achenes golden yellow to dull orange when mature *E. elliptica*
  - *9.* Tubercle long-conic-subulate, much narrower than the plump achene *E. intermedia*

E. acicularis (L.) R. & S. Muddy borders of ponds; frequent. Miller Pond on Stissing Mountain, *3877;* Forest Lake, *2078;* Kinderhook Lake, *House 13419**; Bachus Pond, *915;* Merwins' Lake, *1239.*

[1] Specimens of *Eleocharis* designated by an asterisk (*) have been determined by Dr. H. K. Svenson.

E. **Engelmanni** Steud. Known only from shores of Kinderhook Lake, *House 16785*, 19604**

E. **ovata** (Roth) R. & S. Tidal mud along the Hudson River. Otherwise unknown. Poelsburg, *3809;* Columbiaville, *3714;* Hudson, *Svenson* (Rhodora 31: 211. 1929). These specimens were originally determined as *E. diandra* C. Wright, a species now reduced to synonymy.

E. **obtusa** (Willd.) Schultes. Wet places; common throughout.

E. **olivacea** Torr. Known only from marshes at the south end of Knickerbocker Lake, *1995, 3827.* Reported from Pine Plains by Hoysradt (1875-79).

E. **palustris** (L.) R. & S. Borders of lakes and ponds; infrequent. No Bottom Pond, *1958;* [East Nassau, *House 21947*]. Well known from Rensselaer County northward. In our area commonly represented by var. **major** Sonder. [Kinderhook Lake; 5 miles north of Ancramdale; 1 mile south of Poelsburg]. Most reports of *E. palustris* from this part of the Hudson Valley are based upon *E. calva* and *E. Smallii.*

E. **Smallii** Britton. Borders of ponds; apparently rather infrequent. Crooked Lake, Sand Lake, *House 21689a;* Kinderhook Lake, *House 16789*, 19609*;* pond 1 mile south of Taghkanic Lake, *1628* (PENN), *House 20520*.*

E. **calva** Torr. Wet meadows, stream banks, borders of ponds; frequent. New Lebanon, *House 21314;* Brainard, *House 21387;* North Chatham, *House 21323;* Robinson Pond, *House 20604*;* 1 mile west of Ancramdale, *3397;* Stuyvesant Falls, *1025;* Columbiaville, *776;* mud flats between Hudson and Athens, *Muenscher & Clausen 4380.*

E. **tenuis** (Willd.) Schultes. Known in our area only from a meadow east of Blue Hill, *House 22693.*

E. **elliptica** Kunth. Wet meadows, swampy places, rather frequent. Queechy Lake, *Harriet Wheeler* (CU)*; 2 miles east of Elizaville, *3202;* 3 miles north of Ancramdale, *3402a;* 1 mile north of Kinderhook, *791;* Rhinecliff, *House 19270*.*

E. **intermedia** Schultes. Calcareous marshes; there abundant; otherwise unknown. Knickerbocker Lake, *Brown 516*;* north of Copake Falls, *3908;* south of Pulvers Corners, *3869;* Pine Plains, *Hoysradt* (NY)*.

3. **Bulbostylis** Kunth

B. **capillaris** (L.) C. B. Clarke. Sandy or dry soil; infrequent, but locally abundant. 1 mile north of Kinderhook, *1718.* Reported as common at Pine Plains by Hoysradt (1875-79).

4. **Fimbristylis** Vahl

F. **autumnalis** (L.) R. & S. Known only from muddy shores of No Bottom Pond, *1947* (PENN), but reported from Pine Plains (Thompsons' Pond) by Hoysradt (1875-79).

5. **Eriophorum** L. "Cotton grass"

1. Spikelet solitary, terminal, not subtended by a leafy involucre; leaves narrow, basal — *E. spissum*
1. Spikelets 2 to several, surrounded by a leafy involucre, *2*
  2. Involucre a single erect short bract; leaves 1 to 1.5 mm. broad; upper stem-leaf with the sheath longer than the blade. — *E. gracile*
  2. Involucral bracts 2 or more; leaves 1.5 to 6 mm. wide, *3*
    3. Bristles whitish; scales greenish to lead color, with one prominent rib extending to the tip — *E. viridi-carinatum*

3. Bristles copper color or brown; scales greenish to straw color with red-brown margin, with several prominent ribs *E. virginicum*

E. spissum Fern. Sphagnum bogs; rare. Bog south of Niverville, *728.*

E. gracile W. D. J. Koch. Floating bogs; rare. Bog west of Douglas Knob, New Lebanon, *1268;* 3 miles southeast of Harlemville, *1134.*

E. viridi-carinatum (Engelm.) Fern. Open swampy meadows and bogs; frequent. West of Douglas Knob, *1269;* 1 mile south of Canaan, *743;* Miller Pond, Ancram, *1074;* 3 miles north of Ancramdale, *817;* bog southeast of Knickerbocker Lake, *1022;* bog west of Post Road School, *174* (PENN), *506.*

E. virginicum L. Sphagnum bogs; there abundant. Taplins' Pond, *2417* (PENN); Niverville, *1442;* 3 miles southeast of Harlemville, *House 20585;* [1 mile west of East Nassau, *House 23975*].

6. **Scirpus** L.

1. Involucre none, or merely the modified outer scale of the solitary terminal spikelet, *2*
2. Perianth bristles short, not exceeding the scales, terete, upwardly setulose *S. verecundus*
2. Perianth bristles in fruit 2 to 3 cm. long, much exceeding the scales, white, flattened, not barbed *S. hudsonianus*
1. Involucre foliaceous or appearing to be a continuation of the culm, *3*
3. Involucre consisting of a firm green erect bract, appearing to be a continuation of the culm; culms not leafy, *4*
4. Spikelets solitary; culms flaccid *S. subterminalis*
4. Spikelets normally more than one; culms firm, *5*
5. Spikelets in sessile clusters, *6*
6. Annuals with tufted roots; culms terete *S. Smithii*
6. Perennials with running rootstocks; culms sharply trigonous, *7*
7. Scales reddish brown, ciliate, awn-tipped; achene planoconvex *S. americanus*
7. Scales yellowish brown, entire, mucronate; achenes trigonous *S. Torreyi*
5. Spikelets more or less loosely umbellate or paniculate, *8*
8. Achene 2 mm. long; scales 2 to 2.5 mm. long, subglabrous, scarcely spotted; spikelets ovoid to subcylindric; culms usually relatively soft *S. validus*
8. Achenes 2.5 mm. long; scales 3 to 4 mm. long, more or less viscid-puberulent on back and much spotted; spikelets mostly cylindrical; culms usually firm and hard *S. acutus*
3. Involucral bracts 2 or more, leaflike; culms leafy, *9*
9. Spikelets large, 10 to 50 mm. long, 5 to 10 mm. wide; culms sharply 3-angled; plants stout, 1 to 2.5 m. high *S. fluviatilis*
9. Spikelets smaller, 2 to 15 mm. long, 1 to 3 mm. wide; culms obtusely 3-angled or terete, *10*
10. Bristles retrorsely barbed; culms mostly solitary, the short caudex bearing thick scaly stolons, *11*
11. At least the lower sheaths red-tinged; bristles barbed nearly to the base *S. microcarpus*
11. Sheaths green; bristles barbed above the middle only, *12*
12. Bristles shorter than or about equaling the achene; spikelets dark brown or dark lead color, *13*
13. Lower sheaths nodulose-reticulate *S. atrovirens*
13. Lower sheaths smooth, not nodulose *S. atrovirens* var. *georgianus*

12. Bristles about twice as long as the achene; spikelets reddish brown *S. polyphyllus*

10. Bristles smooth or with few scattered or ascending hairs, not regularly retrorsely barbed; plants in dense or loose clumps, not stoloniferous, *14*

14. Bristles not exceeding the scales *S. lineatus*

14. Bristles much exserted at maturity, *15*

15. Spikelets sessile or nearly so, in glomerules of 3 to 15; achenes maturing from August to October *S. cyperinus*

15. Spikelets nearly all pedicelled (at least the lateral ones of each group); achenes maturing from June to early August, *16*

16. Involucels and scales dull or pale brown; culms stout, mostly 1 to 1.5 m. high *S. pedicellatus*

16. Involucels and scales dark lead color to black; culms slender, 0.5 to 1.2 m. high *S. atrocinctus*

S. verecundus Fern. Dry wooded hillsides, often in calcareous soil; infrequent but widely distributed. Brainard, *House 21368;* Millerton, *House 22425;* 3 miles north of Claverack, *544;* east of Blue Hill, *House 22659;* Pinnacle Rocks, 3 miles southeast of Churchtown, *4183;* 1 mile southeast of Kinderhook, *4358.*

S. hudsonianus (Michx.) Fern. Known only from a floating bog west of Douglas Knob, New Lebanon, *1270.*

S. subterminalis Torr. Reported by Hoysradt (1875-79) from "Lee Pond, Mount Riga," which may be the Lee Pond in Mount Washington, Berkshire County, one of the sources of Bashbish Brook.

S. Torreyi Olney. Swampy border of pond 1 mile south of Miller Pond, Ancram, *House 23679.* Otherwise unknown.

S. Smithii Gray. Tidal mud along the Hudson River; there rather abundant. Otherwise known only from Knickerbocker Lake, *1993, 3828.* Coeymans, Albany County, *Svenson* (Rhodora 26: 222. 1925); Poelsburg, *3808;* Nutten Hook, *Muenscher & Clausen 4420* (CU); Hudson, *Muenscher & Clausen 4419* (CU); shores of Hudson River east of Rogers Island, *2954.*

S. americanus Pers. Tidal flats and marshes along the Hudson River; there common, often forming a dense growth. Otherwise unknown except through a report from Copake Lake, *Muenscher* (1935, p. 245). Hotaling Island, *Taylor 1369* (NY); Stuyvesant, *933;* Hudson, *Muenscher & Clausen 4409* (CU); Rogers Island, *2580.*

S. validus Vahl. "Bulrush." Swamps, bogs and along streams; frequent. Kinderhook Lake, *House 11316;* 1 mile north of Kinderhook, *969;* bog southeast of Knickerbocker Lake, *1160;* Hudson, tidal flats, *House 20505.*

S. acutus Muhl. Swampy borders of lakes and ponds and in tidal marshes; infrequent. Waldorf Pond, *House 21753;* Knickerbocker Lake, *1807;* pond south of Miller Pond, Ancram, *House 20540;* Nutten Hook, *Muenscher & Clausen 4406* (CU).

S. fluviatilis (Torr.) Gray. Tidal marshes along Hudson River, where very abundant. Otherwise known only from Kinderhook Lake, *House 18858;* Hotaling Island, *3146;* Stuyvesant, mouth of Mill Creek, *1817;* Hudson, *House 20490;* Crugers' Island, *2898.*

S. microcarpus Presl. *(S. rubrotinctus* of *Gray's Manual).* Moist meadows, apparently infrequent. Brainard, along Kinderhook Creek, *House 18415;* 1 mile north of Kinderhook, *962.* Increasingly abundant northward on the Rensselaer County plateau region.

S. atrovirens Willd. Wet meadows and swamps; common. North Chatham, *1112;* Copake Falls, *Britton et al.* (NY); 1 mile north of Kinderhook, *786;* 1.5 miles east of Hollowville, *3760.*

Var. **georgianus** (Harper) Fern. Appearing locally with the typical plant; Curtis Mountain, *House 21473;* Tivoli, *2722;* [Brainard, *House 21473;* No Bottom Pond, *4523*].

S. polyphyllus Vahl. Moist meadows; apparently infrequent. "Not common" at Pine Plains, according to Hoysradt (1875-79); 1 mile north of Kinderhook, *2160.*

S. lineatus Michx. Swampy meadows; very abundant locally in the Hudson Valley and in the calcareous marshes of the Harlem Valley. 3 miles north of Ancramdale, *3343;* ½ mile northwest of Clermont, *3258;* 2 miles south of Germantown, *4764* (USNA); 2 miles south of West Ghent, *4768* (USNA).

S. cyperinus (L.) Kunth. "Wool grass." Swamps and borders of ponds and streams; common. Lebanon Springs; Chatham Center; Forest Lake; New Forge; Niverville; Rogers Island; 2 miles west of Nevis; 2 miles south of Claverack. Practically all Columbia County material seems to correspond to var. **pelius** Fern. with an occasional plant having the congested inflorescence of forma **condensatus** (Fern.) S. F. Blake.

S. atrocinctus Fern. Swamps and marshy borders of ponds; infrequent. Near Curtis Mountain, *House 21488;* Brainard, *House 18414;* No Bottom Pond, *1337;* Fowlers' Lake, *1669.*

S. pedicellatus Fern. Wet meadows; local or rare. Kinderhook Lake, *House 16792;* New Baltimore, Greene County, *House 21626;* abundant in meadows 4 miles north of Castleton, near Hudson River, *4535.*

7. **Dulichium** Pers.

D. arundinaceum (L.) Britt. Swamps and along streams; frequent. Pond south of Taghkanic Lake, *1625* (PENN); Chatham, *Harriet Wheeler* (CU); New Forge, *3492;* bog southeast of Knickerbocker Lake, *1441;* Kinderhook, *1377;* Hudson, *House 20512;* Tivoli, tidal marsh, *2785.*

8. **Rhynchospora** Vahl

1. Spikelets white or tawny in age; stamens usually 2; bristles 9 to 12 or more *R. alba*

1. Spikelets chestnut colored; stamens 3; bristles 6 (rarely 12) *R. capillacea*

R. alba (L.) Vahl. Wet meadows and sphagnum bogs; locally very abundant. Copake Falls, *Britton et al.* (NY); 3 miles southeast of Harlemville, *House 20582;* south of Niverville, *1443;* bog west of Douglas Knob, New Lebanon, *2119.*

R. capillacea Torr. Calcareous meadows and marshes; rare. West of Post Road School, *2001;* south of Pulvers Corners, *3847.*

9. **Cladium** P. Br.

C. mariscoides (Muhl.) Torr. Bogs; rare. Knickerbocker Lake, *1230;* Mud pond, 3 miles east of Elizaville, *3280;* Fingar Marsh, Gallatin, *3578.* At the Knickerbocker Lake station associated with *Lobelia Kalmii, Sarracenia purpurea, Ultricularia intermedia, Potentilla palustris, Typha latifolia,* under near-neutral conditions. At the other known stations it is found in highly acid sphagnum bogs.

10. **Carex** L.[1] Sedge

Key to the Sections

1. Spike 1, *2*
  2. **Perigynia strongly inflated, sessile or nearly so, not becoming reflexed; pistillate scales persistent** 34. **Squarrosae** (p. 87)
  2. **Perigynia not inflated,** *3*
    3. **Pistillate scales not foliaceous; perigynia not abruptly beaked** 9. **Polytrichoideae** (p. 78)
    3. **Lower pistillate scales foliaceous; perigynia abruptly beaked** 10. **Phyllostachyae** (p. 78)
1. Spikes more than 1, *4*
  4. Stigmas 2; achenes lenticular, *5*
    5. **Lateral spikes sessile, short; terminal spike usually androgynous or gynaecandrous,** *6*
      6. **Spikes androgynous, many-flowered; perigynia not subterete,** *7*
        7. Perigynia abruptly contracted into the beak, culms not flaccid **and not flattening in drying,** *8*
          8. **Spikes few (generally 10 or fewer), usually greenish** 1. **Bracteosae** (p. 73)
          8. Spikes numerous, yellowish or brownish at maturity; leaf **sheaths often red-dotted ventrally,** *9*
            9. **Perigynia planoconvex, thin, yellowish; bracts mostly much exceeding the spikes; leaf sheaths usually transversely rugulose ventrally** 2. **Multiflorae (p. 74)**
            9. **Perigynia thick-planoconvex or unequally biconvex, brown; bracts mostly shorter than the spikes; leaf** sheaths not transversely rugulose 3. **Paniculatae** (p. 75)
        7. **Perigynia tapering into the beak; culms flaccid and flattening** in drying 4. **Vulpinae** (p. 75)
      6. **Spikes not androgynous or,** if so, perigynia subterete and spikes **only 1- to 3-flowered,** *10*
        10. **Perigynia without winged margins,** at most thin-edged, *11*
          11. **Perigynia 2 to 3.75 mm. long,** *12*
            12. **Perigynia not thin-edged, ascending or appressed, elliptic** 5. **Heleonastes** (p. 75)
            12. **Perigynia thin-edged, spreading, ovoid, broadest below** the middle 6. **Stellulatae** (p. 76)
          11. **Perigynia 4.5 to 5.5 mm. long, narrowly lanceolate, appressed** 7. **Deweyanae** (p. 76)
        10. Perigynia with winged margins 8. **Ovales** (p. 76)
    5. Lateral spikes peduncled or, if sessile, elongate; terminal spike **usually staminate,** *13*
      13. **Plants 5 to 45 (55) cm. high; pistillate spikes 4 to 20 mm. long; lowest bract long-sheathing; perigynia golden yellow at maturity.** 15. **Bicolores** (p. 80)
      13. **Plants (25) 35 to 120 cm. high; pistillate spikes (15) 20 to 100 mm. long; lowest bract sheathless or rarely short-sheathing; perigynia not golden yellow,** *14*
        14. Pistillate scales not long-awned, 1-nerved; achenes not con**stricted in the middle** 30. **Acutae** (p. 85)
        14. **Pistillate scales long-awned, 3-nerved; achenes constricted in** the middle 31. **Cryptocarpae** (p. 86)

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[1] The key to the genus *Carex* has been contributed by Dr. F. J. Hermann of the U. S. Department of Agriculture. Specimens of *Carex* designated by an asterisk (*) have been determined by the late K. K. Mackenzie.

4. Stigmas 3; achenes triangular, *15*
 - *15.* Perigynia pubescent or scabrous, *16*
   - *16.* Style articulated with the achene, at length deciduous, *17*
     - *17.* Achenes closely enveloped by the perigynia; bracts sheathless or nearly so, *18*
       - *18.* Plant (except perigynia) glabrous — 11. **Montanae** (p. 78)
       - *18.* Plant pubescent — 13. **Triquetrae** (p. 80)
     - *17.* Achenes not closely enveloped by the perigynia or, if so, the bracts strongly sheathing, *19*
       - *19.* Bracts sheathing, their blades rudimentary — 12. **Digitatae** (p. 79)
       - *19.* Bracts with well-developed blades, *20*
         - *20.* Perigynia pubescent, *21*
           - *21.* Beak of perigynium strongly bidentate; styles long, slender — 26. **Hirtae** (p. 85)
           - *21.* Beak of perigynium at most shallowly bidentate; styles very short, thickish — 25. **Virescentes** (p. 84)
         - *20.* Perigynia scabrous — 27. **Anomalae** (p. 85)
   - *16.* Style continuous with the achene, persistent, indurated, *22*
     - *22.* Perigynia less than 1 cm. long; spikes cylindric — 33. **Paludosae** (p. 87)
     - *22.* Perigynia 1 cm. long or longer; spikes globose — *C. Grayii* in 36. **Lupulinae** (p. 88)
 - *15.* Perigynia glabrous, *23*
   - *23.* Style articulated with achene, at length deciduous, *24*
     - *24.* Achenes strongly constricted at the base, rounded at the apex; lower pistillate scales bractlike — 10. **Phyllostachyae** (p. 78)
     - *24.* Achenes not strongly constricted at the base, apiculate at the apex; lower pistillate scales not bractlike, *25*
       - *25.* Bracts, at least the lower ones, long-sheathing, *26*
         - *26.* Bracts bladeless or with rudimentary blades, *27*
           - *27.* Leaf blades filiform — 14. **Albae** (p. 80)
           - *27.* Leaf blades not filiform — 17. **Laxiflorae** (p. 80)
         - *26.* Bracts with well-developed blades, *28*
           - *28.* Foliage, especially the sheaths, pubescent or puberulent, *29*
             - *29.* Perigynia beakless or short-beaked; terminal spike gynaecandrous (rarely staminate in *C. gracillima*) — 21. **Gracillimae** (p. 82)
             - *29.* Perigynia conspicuously beaked; terminal spike staminate — 22. **Sylvaticae** (p. 83)
           - *28.* Foliage glabrous, *30*
             - *30.* Beak of perigynium not bidentate, at most emarginate, *31*
               - *31.* Pistillate spikes short, oblong to linear, erect or nearly so; if drooping, either on capillary peduncles or perigynia acutely triangular, *32*
                 - *32.* Perigynia with few to many strongly raised nerves, *33*
                   - *33.* Perigynia tapering at the base, triangular, closely enveloping the achenes, *34*
                     - *34.* Rootstocks elongate, often producing long horizontal stolons — 16. **Paniceae** (p. 80)
                     - *34.* Rootstocks not elongate, not producing long horizontal stolons — 17. **Laxiflorae** (p. 80)

33. Perigynia rounded at the base, suborbicular in cross section, loosely enveloping the achene 18. **Granulares** (p. 81)

32. Perigynia with numerous fine impressed nerves, *35*

35. Perigynia tapering at the base, constricted at the apex, obtusely triangular, closely enveloping the achenes 19. **Oligocarpae** (p. 82)

35. Perigynia rounded at both ends, orbicular to orbicular-triangular in cross section 20. **Griseae** (p. 82)

31. Pistillate spikes elongate, linear to cylindric, on slender peduncles, the lower usually drooping; perigynia not acutely triangular, *36*

36. Perigynia beakless or short-beaked; terminal spike gynaecandrous 21. **Gracillimae** (p. 82)

36. Perigynia conspicuously beaked; terminal spike staminate 22. **Sylvaticae** (p. 83)

30. Beak of perigynium bidentate, *37*

37. Pistillate spikes oblong-cylindric on slender, drooping peduncles 23. **Longirostres** (p. 83)

37. Pistillate spikes suborbicular or short-oblong, on short erect or ascending peduncles or sessile 24. **Extensae** (p. 84)

25. Lower bracts sheathless or very short-sheathing, *38*

38. Terminal spike staminate (in *C. prasina* occasionally bearing a few perigynia), *39*

39. Perigynia rounded and minutely beaked at the apex; pistillate spikes oblong, 1 to 2.5 cm. long 28. **Limosae** (p. 85)

39. Perigynia tapering into a beak nearly the length of the body; pistillate spikes linear, 2 to 6 cm. long *C. prasina* in 21. **Gracillimae** (p. 83)

38. Terminal spike gynaecandrous 29. **Atratae** (p. 85)

23. Style not articulated, continuous with the achene, persistent, indurated, *40*

40. Perigynia subcoriaceous and firm 33. **Paludosae** (p. 87)

40. Perigynia membranaceous, *41*

41. Perigynia obconic or broadly obovoid, truncately contracted into long subulate beaks 34. **Squarrosae** (p. 87)

41. Perigynia from lanceolate to ovoid or globose-ovoid, not truncately contracted, *42*

42. Perigynia finely and closely ribbed 32. **Pseudo-Cypereae** (p. 86)

42. Perigynia coarsely ribbed, *43*

43. Perigynia 7 to 10 mm. long; achenes 2 to 3 mm. long, 1.25 to 2.25 mm. wide 35. **Vesicariae** (p. 87)

43. Perigynia 10 to 20 mm. long; achenes 2.5 to 6 mm. long, 2 to 4 mm. wide 36. **Lupulinae** (p. 88)

Section 1. Bracteosae

1. Sheaths tight, inconspicuously or not at all mottled with green and white nor septate-nodulose dorsally; leaf blades 1 to 4.5 mm. wide, *2*

2. Perigynia distended and spongy at the base, usually widely spreading or reflexed at maturity, *3*

3. Beaks of perigynia smooth, scarcely exceeding the acuminate, deciduous scales *C. retroflexa*

3. Beaks of perigynia minutely serrulate, much exceeding the obtuse or somewhat acute, persistent scales, *4*
4. Stigmas long, slender, usually not twisted; perigynium tapering into the beak; leaf blades 1 to 2 mm. wide *C. rosea*
4. Stigmas short, stout, strongly twisted or contorted; perigynium abruptly contracted into the beak, *5*
5. Leaf blades 1.5 to 3 (averaging 2.5) mm. wide; spikes with 6 to 20 perigynia; perigynia 3.25 to 4.5 mm. long *C. convoluta*
5. Leaf blades 1 to 1.75 mm. wide; spikes with 2 to 6 perigynia which are 2.25 to 3 mm. long *C. radiata*
2. Perigynia not distended nor spongy at the base, mostly ascending, *6*
6. Inflorescence ovoid; spikes densely capitate *C. cephalophora*
6. Inflorescence oblong or linear-oblong to elongate and interrupted; spikes not capitate *C. Muhlenbergii*
1. Sheaths loose, mottled with green and white and usually septate-nodulose dorsally; leaf blades 3 to 10 mm. wide, *7*
7. Mature perigynia membranaceous, narrowly ovate to elliptic, flat ventrally, with a narrow, gradually contracted beak; leaf blades 3 to 7 mm. wide; spikes approximate or the lower separate *C. cephaloidea*
7. Mature perigynia subcoriaceous, ovate, with border raised ventrally, abruptly contracted into a short stout beak; leaf blades 5 to 10 mm. wide *C. sparganioides*

C. retroflexa Muhl. Hudson Valley; widely distributed, but not common. Unknown eastward. Pine Plains, *Hoysradt* (NY*, CU); Blue Hill, *House 22676;* Kinderhook, *655* (NYS, PENN).

C. rosea Schkuhr. Woods and thickets; frequent. Mount Lebanon; Copake Falls; Kinderhook; Clermont; Brainard; Pine Plains, *Hoysradt* (NY*).

C. convoluta Mackenz. Woods and thickets, throughout. Pine Plains, *Hoysradt* (CU); Queechy Lake, *Harriet Wheeler* (CU); Green River, *1519;* North Chatham, *House 20459;* Blue Hill, *House 22652.*

C. radiata (Wahlenb.) Dew. Moist woods and thickets; frequent eastward, but unknown in the Hudson Valley. Mount Lebanon, *House 15597**; No Bottom Pond, *1329;* 1.5 miles northeast of Hillsdale, *3548;* Copake Falls, *Britton et al.* (NY*); Pine Plains, *Hoysradt* (NY*); [Bashbish Gorge, *Dobbin 936*].

C. cephalophora Muhl. Dry meadows and hillsides; frequent. New Lebanon; Harlemville; Ancram, near Miller Pond; Brainard; North Chatham; Kinderhook Lake; Blue Hill; Tivoli; Elizaville; Chatham, *Wheeler* (CU); Pine Plains, *Hoysradt* (CU).

C. Muhlenbergii Schkuhr. Dry soil, apparently infrequent. Pine Plains, *Hoysradt* (NY*); North Chatham, *House 21553;* [2 miles southeast of Nassau, *House 23610*].

C. cephaloidea Dew. Known only through a specimen from the herbarium of William Boott, now in the New York Botanical Garden, which bears the note "fr. Lyman Hoysradt," and is probably from Pine Plains.

C. sparganioides Muhl. Woods and thickets; apparently rather frequent in the Hudson Valley and less so eastward. Lebanon Springs, *Wheeler* (CU); Pine Plains, *Hoysradt* (CU, NY*); Rhinecliff, *House 19286;* 2.5 miles west of Clermont, *3267;* Kinderhook Lake, *House 21442.*

Section 2. **Multiflorae**

1. Beak of perigynium much shorter than the body; leaves usually shorter than the culms *C. annectens*

1. Beak of perigynium about equaling the body; leaves normally exceeding the culms *C. vulpinoidea*

C. annectens (Bickn.) Bickn. Meadows and dry grassy woodlands, frequent or common. 1 mile south of Taghkanic Lake, *House 20531;* Brainard, *House 21533;* Kinderhook Lake, *House 16798, 21439;* 2 miles east of Elizaville, *3195;* Mount Lebanon, *House 15593**; New Britain, *House 23642.* Represented in our area by var. **xanthocarpa** (Kükenth.) Wieg. The only collection I have seen which approaches typical *C. annectens* is *House 21410,* from Brainard.

C. vulpinoidea Michx. Wet meadows and swampy places; common.

Section 3. Paniculatae

1. Sheaths not copper-colored at the mouth; perigynia 2 to 2.25 mm. long, convex ventrally, lustrous, not concealed by the scales *C. diandra*
1. Sheaths copper-colored at the mouth; perigynia 2.5 to 3.5 mm. long, flat or concave ventrally, dull, nearly concealed by the scales *C. prairea*

C. diandra Schrank. Wet places; rare. Pine Plains, *Hoysradt* (CU, NY*). Otherwise unknown.

C. prairea Dew. Calcareous marshes. Attlebury, *Hoysradt* (NY*); "vicinity of Pine Plains," *Hoysradt* (CU, GH*); Miller Pond, Ancram, *3114;* north of Copake, according to Knowlton (1919).

Section 4. Vulpinae

1. Sheaths not thickened at the mouth, cross-rugulose ventrally, easily broken, prolonged upward at the mouth *C. stipata*
1. Sheaths thickened (often cartilaginous) at the mouth, rarely cross-rugulose ventrally, not easily broken, concave or truncate at the mouth *C. laevivaginata*

C. stipata Muhl. Wet meadows and swampy places; common.

C. laevivaginata (Kükenth.) Mackenz. Wet meadows and swampy places; rare. North Chatham, *House 21550;* Pine Plains, *Hoysradt* (CU).

Section 5. Heleonastes

1. Spikes androgynous; perigynia unequally biconvex *C. disperma*
1. Spikes gynaecandrous; perigynia planoconvex, *2*
   2. Lowest bract bristlelike, many times longer than its spike; perigynia 3 to 3.5 mm. long *C. trisperma*
   2. Lowest bract much shorter; perigynia about 2 mm. long, *3*
      3. Perigynia distinctly short-beaked, loosely spreading; leaves green, 1 to 2.5 mm. wide *C. brunnescens*
      3. Perigynia apiculate, appressed-ascending; leaves glaucous, 2 to 4 mm. wide *C. canescens*

C. disperma Dew. Wet sphagnous woods, where rather abundant. Unknown in the Hudson Valley. Pine Plains, *Hoysradt* (CU, NY*); 3 miles north of Nassau, *House 21761;* New Britain, *4301;* 2.5 miles east of Chatham Center, *3684;* bog 2 miles south of Copake Lake, *3445.* Reported by Hoysradt from the "Fingar Swamp," town of Gallatin.

C. trisperma Dew. Sphagnum bogs; local. Averill Park, *House 6347**; New Britain, *3641;* bog southeast of Knickerbocker Lake, *1159;* Pine Plains, *Hoysradt* (CU, NY*).

C. brunnescens (Pers.) Poir. Mount Everett, *5035* (USNA); Pine Plains, *Hoysradt* (NY*); *House 21270,* from New Lebanon, resembles this species.

C. canescens L. Bogs, usually in sphagnum. Locally abundant. New Lebanon, *House 21273;* 0.5 miles south of Niverville, *867;* bog southeast of Knickerbocker Lake, *1158;* Pine Plains, *Hoysradt* (CU); "Jno. White Swamp" (Pine Plains), *Hoysradt* (NY*). Represented in our area only by var. **disjuncta** Fern.

Section 6. **Stellulatae**

C. interior Bailey. Swampy places. Pine Plains, *Hoysradt* (CU, NY*); Kinderhook, *787.*

Section 7. **Deweyanae**

1. Spikes narrowly linear; perigynia 1 to 1.3 mm. wide, nerved on both sides *C. bromoides*

1. Spikes oblong-ovoid; perigynia 1.5 to 2 mm. wide, nerveless ventrally *C. Deweyana*

C. bromoides Schkuhr. Rich or moist woods; infrequent. New Lebanon, *House 21271;* Spencertown, *4122;* Bashbish Gorge, Copake, according to Knowlton (1919); Millerton, *House 22399* (in flower only); Pine Plains, Stissing Notch, *Hoysradt* (NY*). In the Hudson Valley known only through reports from Rhinecliff and Blue Hill (House).

C. Deweyana Schwein. Rich or moist woods; apparently rare. 2 miles south of Flatbrook, *3604;* rare along Roeliff Jansen Kill near Pine Plains, according to Hoysradt (1875-79); [1 mile east of Canaan, *4255.* Mount Lebanon and Brainard, according to House].

Section 8. **Ovales**

1. Scales shorter than the perigynia and noticeably narrower above, largely exposing the perigynia above, *2*

2. Wing of perigynium not narrowed near the middle of the body; leaf blades of sterile culms erect or ascending, usually clustered toward the top, *3*

3. Perigynia not obovate, widest near the middle or base, *4*

4. Perigynia lanceolate to narrowly ovate-lanceolate, 3 to 4 times as long as wide *C. scoparia*

4. Perigynia ovate-lanceolate or broader, at most twice as long as wide, *5*

5. Perigynia 3 to 4 mm. long, narrowly to broadly ovate, *6*

6. Leaf blades 1.5 to 4.5 (averaging 2.5) mm. wide; sheaths not mottled with green and white dorsally, *7*

7. Perigynia 3 to 3.5 mm. long; spikes closely aggregated, not clavate at base *C. Bebbii*

7. Perigynia 3.5 to 4 mm. long; spikes aggregated to strongly separate, clavate at base *C. tenera*

6. Leaf blades 2.5 to 6 (averaging 4.0) mm. wide; sheaths mottled with green and white dorsally; perigynia less abruptly beaked and beak narrower than in *C. tenera* *C. normalis*

5. Perigynia 3.75 to 6.5 mm. long, the body suborbicular, *8*

8. Perigynia planoconvex, thick, 3.75 to 5.5 mm. long, *9*

9. Perigynia ovate, submembranaceous, few-nerved ventrally, broadest near the base, tapering into the beak, the beak broader than in *C. brevior,* especially toward the base *C. molesta*

9. Perigynia broadly ovate to suborbicular, coriaceous, usually nerveless or nearly so ventrally, broadest near the middle, abruptly contracted into the beak *C. brevior*

8. Perigynia flat and thin, nearly transparent, 5.6 to 6.5 mm. long *C. Bicknellii*

3. Perigynia obovate, the body widest near the top, *10*

10. Spikes densely aggregated; tips of perigynia appressed; perigynia with body rounded at the apex *C. cumulata*

10. Spikes not aggregated; tips of perigynia spreading; perigynia with body truncate-rounded at the apex *C. albolutescens*

2. Wing of perigynium rather abruptly narrowed near the middle of the body; leaf blades of sterile culms widely spreading, not clustered at the apex, *11*

11. Perigynia thin and scalelike, scarcely distended over the achene; heads elongate, *12*

12. Tips of perigynia appressed or ascending; spike more or less turbinate, 5 to 12 mm. long; leaf blades firm; culm stiff *C. tribuloides*

12. Tips of perigynia loosely ascending or at length recurved; spikes not turbinate, 4 to 8 mm. long; leaf blades flaccid; culms not stiff *C. projecta*

11. Perigynia planoconvex, obviously distended over the achene, the tips widely spreading to strongly recurved; culms stiff; heads dense, oblong *C. cristatella*

1. Scales about the length of the perigynia and about the same width above, concealing the perigynia above or nearly so, *13*

13. Perigynia nerveless ventrally or occasionally few-nerved, brownish and at maturity black dorsally, the body usually widest near the base, scales dull or reddish brown *C. aenea*

13. Perigynia conspicuously many-nerved ventrally, greenish white, the body usually widest near the middle; scales silvery green *C. argyrantha*

C. scoparia Schkuhr. Meadows and thickets, usually in moist soil; common and abundant.

C. Bebbii Olney. Pine Plains, *Hoysradt* (NY*). Otherwise unknown.

C. tenera Dew. Moist meadows and thickets; widely distributed. New Lebanon, *House 21265;* Pine Plains, *Hoysradt* (CU, NY*); Brainard, *House 21414;* North Chatham, *House 21331;* Kinderhook Lake, *House 21445.*

C. normalis Mackenz. On banks, in open woods and thickets, according to House (1924). Pine Plains, *Hoysradt* (NY*); Brainard, *House 21377;* North Chatham, *House 21332.*

C. brevior (Dew.) Mackenz. Woods and thickets, apparently rare. Kinderhook Lake, *House 21440;* Mount Merino, *Peck*;* clearing north of Brace Mountain, Northeast, *4485.*

C. molesta Mackenz. Swamp south of Kinderhook Lake, *House 21441.* Otherwise unknown.

C. Bicknellii Britt. Dry shaly banks, apparently infrequent. Pine Plains, *Hoysradt* (NY*); Little Stissing Mountain, *Peck*;* north of North Chatham, *House 19623.*

C. cumulata (Bailey) Mackenz. Shaly banks and ledges; apparently rare. Pine Plains, *Hoysradt* (CU); Mount Riga, *Hoysradt* (NY*); Bashbish Falls, *Hoffmann* (NEBC*); abundant and weedy in clearings near the summit of Brace Mountain, *4486.*

C. albolutescens Schwein. A collection from Pine Plains, *Hoysradt,* was referred to this species [as *C. straminea*] by Mackenzie (NY*). Otherwise unknown.

C. tribuloides Wahlenb. Wet or muddy places; frequent in the Hudson Valley and apparently decreasing eastward. Unknown from the eastern tier of

towns. Columbiaville, *3717;* New Forge, *3494;* 1 mile northeast of Blue Stores, *3207*; Livingston, *Carrie Harrison* (CU); Pine Plains, *Hoysradt* (NY*); Chatham, *Harriet Wheeler* (CU).

C. **projecta** Mackenz. New Lebanon, *House 21286;* [East Nassau, *House 24627;* Brainard, *House 21413;* west face of Brace Mountain, *House 24856*].

C. **cristatella** Britt. Wet meadows and swampy places; frequent in the Hudson and Harlem Valleys. Unknown from the higher elevations to the eastward. North Chatham, *House 21552;* Chatham, *Harriet Wheeler* (CU); Hotaling Island, *3135;* Hudson, South Bay, *House 20502;* Pine Plains, *Hoysradt* (NY*); Long Pond, Ancram, *3432.*

C. **aenea** Fern. Dry woods; rare. Summit of Brace Mountain, *House 24804;* 1.5 miles south of Ancramdale, *3381.* Otherwise unknown.

C. **argyrantha** Tuckerm. Rocky woods; apparently rather frequent at the higher elevations eastward; unknown in the Hudson Valley. Brainard, *House 7170*;* Douglas Knob, New Lebanon, *3629;* Mount Fray, Copake, *2651* (PENN); Stissing Mountain, *Peck*;* Stissing Mountain, *Hoysradt* (NY*).

Section 9. Polytrichoideae

C. **leptalea** Wahlenb. Bogs, often in sphagnum; locally abundant. Queechy Lake, *Harriet Wheeler* (CU); 2 miles southeast of Taghkanic, 3357; cranberry bog near Omi, *3749;* Pine Plains, *Hoysradt* (CU, NY*).

Section 10. Phyllostachyae

C. **Willdenovii** Schkuhr. Dry woods in rather acid soil; rare. East of New Forge, *4386;* "vicinity of Pine Plains," *Hoysradt*, June 28, 1878 (CU); reported by Hoysradt (1875-79) from Lake Charlotte (now Taghkanic Lake).

Section 11. Montanae

1. Fertile culms all alike, elongated (7 to 40 cm. long), bearing both staminate and pistillate spikes; basal spikes absent, *2*
  2. Body of perigynium elliptic to oblong-ovoid, much longer than wide, *3*
    3. Staminate spike very slender, 4 to 16 mm. long, 0.5 to 1 mm. wide; culms very loosely caespitose, rarely fibrillose at the base *C. novae-angliae*
    3. Staminate spikes relatively stout, 2 to 14 mm. long, 1.25 to 2 mm. wide; culms densely caespitose, conspicuously fibrillose at the base, *4*
      4. Staminate scales obtuse or short-acute, closely appressed, not cucullate at the tip, the midvein usually not extending to the tip; staminate spike usually conspicuous; pistillate spikes usually not aggregated *C. artitecta*
      4. Staminate scales acuminate, ascending to loosely spreading and cucullate at the tip, the midvein extending to the tip; staminate spike usually inconspicuous; pistillate spikes closely aggregated *C. Emmonsii*
  2. Body of perigynium suborbicular or somewhat obovoid, about as long as wide, *5*
    5. Ligule conspicuous, longer than wide; lowest bract truncate or bifid, abruptly awned; leaf blades 2.5 to 4.5 mm. wide; culms little fibrillose at base, without long, horizontal stolons *C. communis*
    5. Ligule short, much wider than long; lowest bract usually gradually acuminate; leaf blades 2.5 (very rarely 3) mm. wide or less; culms conspicuously fibrillose at the base, with long horizontal stolons *C. pensylvanica*

1. Fertile culms of 2 types, some short (1 to 5 cm. long), partly hidden among the densely tufted leaf bases and bearing pistillate spikes only; others elongate (5 to 11 cm. long), and bearing staminate spikes only or both staminate and pistillate spikes, *6*

6. Leaf blades rather thin, not stiff, erect or ascending, 1.5 to 3 mm. wide; perigynia membranaceous, 2.25 to 4 mm. long, the body short-pubescent above, *7*

7. Perigynia 2.25 to 3.25 mm. long, 1 to 1.25 mm. wide, the beak about the length of the body; achenes orbicular-obovoid *C. umbellata*

7. Perigynia 3.25 to 4 mm. long, 1.25 to 1.5 mm. wide, the beak nearly the length of the body; achenes oblong-obovoid, minutely roughened *C. rugosperma*

6. Leaf blades thick, rigid, widely spreading at maturity, 2 to 4.5 mm. wide; perigynia subcoriaceous, 3.5 to 4.5 mm. long, the body glabrous or very sparingly pubescent above *C. tonsa*

C. novae-angliae Schwein. Dry soil, banks and woodlands. New Lebanon, *House 21264;* well known from Rensselaer County, north of our range (Sand Lake*; North Greenbush*). Reported from Little Stissing Mountain by Hoysradt (1875-79).

C. artitecta Mackenz. Dry banks, in shady sandy or calcareous soil; frequent, New Baltimore, Greene County, *Peck**; 1 mile north of Kinderhook, *4245;* Becraft Mountain, *4356;* Mount Merino, *4079;* 2 miles southeast of Churchtown, *4182;* Greendale, *4333;* New Forge, *4387;* Pine Plains, *Hoysradt* (NY*); east side of Washburn Mountain, *4222.*

C. Emmonsii Dew. Known only through a plant in the herbarium of Cornell University, collected by Lyman Hoysradt "in the vicinity of Pine Plains," June 6, 1878. The specimen is immature, and may possibly be referred to one of the two preceding species.

C. communis Bailey. Dry or rocky soil, usually in partial shade; frequent. North side of Bashbish Gorge, *4230;* Pine Plains, *Hoysradt* (CU, NY*); New Forge, *4401*; Queechy Lake, *4288;* 0.5 mile east of Clermont, *4338;* Poelsburg, *326* (PENN); Stuyvesant Falls, *295* (PENN); Mount Merino, *4078;* 2 miles east of Spencertown, 4196; 2 miles west of Chatham, *4140;* 2 miles southeast of Churchtown, *4191a.*

C. pensylvanica Lam. Dry sandy or rocky places; common and abundant eastward and less so in the Hudson Valley. Blue Hill, *598;* Mount Merino, *4078;* 1 mile south of Germantown, *4138;* 1 mile north of Kinderhook, *4247.*

C. umbellata Schkuhr (*C. abdita* of *Gray's Manual*) Pine Plains, *Hoysradt* (CU, NY*). Not reported elsewhere.

C. rugosperma Mackenz. *(C. umbellata* of *Gray's Manual).* Dry sandy or rocky places. New Lebanon, *House 21281;* Brainard, *House 21373;* Spencertown, *4125;* 3 miles east of Ghent, *751;* 2 miles southeast of Churchtown, *4188.*

C. tonsa (Fern.) Bickn. Dry sandy or rocky soil, often in exposed places; throughout. Mount Fray, Copake, *2633;* 2 miles southeast of Churchtown, *3504;* Kinderhook, *781;* Nutten Hook, *851;* Germantown, *4137.*

Section 12. **Digitatae**

C. pedunculata Muhl. Dry rocky woods; frequent or common eastward, at elevations of more than 300 m.; rare in the Hudson Valley. West of Post Road School, Kinderhook, *279* (PENN); Canaan, *4259;* Red Rock, *4153;* Washburn Mountain; Millerton, *House 22426;* Pine Plains, *Hoysradt* **(NY*).**

Section 13. **Triquetrae**

C. hirtifolia Mackenz. Wet meadows and flood plains of streams; frequent. New Lebanon, *House 21284;* Chatham, *Harriet Wheeler* (CU); Pine Plains, *Hoysradt* (CU, NY*); New Forge, *4399;* 2 miles southeast of Churchtown, *4191;* Clermont, *4346;* 2 miles east of Greendale, *4321.*

Section 14. **Albae**

C. eburnea Boott. Limestone ledges; rare. Pine Plains, *Hoysradt* (CU, NY*); Old Chatham, *636;* 1 mile south of Canaan Center, *3613;* 1 mile southwest of West Ghent, *3292.*

Section 15. **Bicolores**

C. aurea Nutt. Moist rich woods and meadows; apparently rare. Pine Plains, *Hoysradt* (NY*); 3 miles north of Canaan, *2114.*

Section 16. **Paniceae**

C. tetanica Schkuhr. Calcareous marshes. Pine Plains, *Hoysradt* (CU, NY*); Miller Pond, Ancram, *3113, 3119.*

Section 17. **Laxiflorae**

1. Bract sheaths, base of culms, and staminate scales strongly red-tinged *C. plantaginea*

1. Bract sheaths not red-tinged, base of culms rarely so; staminate scales greenish white to dull reddish-brown-tinged, *2*

2. Perigynia sharply triangular, short-tapering at the base, closely 35- to 50-nerved, *3*

3. Spikes erect, nearly sessile; leaf blades very smooth except for the margins, the larger 12 to 25 mm. wide, those of the fertile culms much smaller than those of the sterile *C. platyphylla*

3. Spikes drooping on filiform peduncles; leaf blades hispidulous on the veins, 2 to 12 mm. wide, those of the fertile culms moderately smaller than those of the sterile, *4*

4. Pistillate spikes without a staminate flower at the base; leaf blades 2 to 5 mm. wide, green *C. digitalis*

4. Pistillate spikes with 1 to 2 staminate flowers at the base; leaf blades 5 to 12 mm. wide, glaucous green *C. laxiculmis*

2. Perigynia obtusely triangular (at least below), long-tapering at the base, *5*

5. Bract sheaths smooth on the edges or shallowly serrulate; beak of the perigynium straight or slightly oblique *C. laxiflora*

5. Bract sheaths strongly serrulate on the edges, *6*

6. Perigynia rather sharply angled above, nerveless or faintly few-nerved, the beak straight or oblique *C. leptonervia*

6. Perigynia very obtusely triangular, conspicuously nerved, the beak abruptly bent, *7*

7. Sterile shoots reduced to tufts of leaves, not forming culms; leaf blades 7 to 30 mm. wide; staminate spike sessile, very slender, inconspicuous; pistillate scales half the length of the perigynia or less, strongly divergent at the base, usually truncate *C. albursina*

7. Sterile shoots developing conspicuous culms; leaf blades 3 to 12 mm. wide; staminate spike sessile to long-pedunculate, conspicuous; pistillate scales more than half the length of the perigynia, not divergent at the base, mucronate to long-awned, *8*

8. Culms not reddish-tinged at the base; lower pistillate spikes not on long capillary peduncles; staminate scales usually white or slightly tinged with reddish brown; staminate spike typically sessile or very short-peduncled; perigynia obovoid, 3 to 4 mm. long *C. blanda*

8. Culms reddish-tinged at the base; lower pistillate spikes on long capillary peduncles; staminate scales strongly tinged with reddish brown; staminate spike long-peduncled; perigynia broadly obovoid, 2.5 to 3.2 mm. long *C. gracilescens*

C. **plantaginea** Lam. Rich rocky woodlands. Known certainly only from Lebanon Springs, *3658.* "Very rare" at Pine Plains, according to Hoysradt (1875-79).

C. **platyphylla** Carey. Dry wooded hillsides; common.

C. **digitalis** Willd. Dry woods; frequent. Lebanon Springs, *Harriet Wheeler* (CU); Brainard, *House 21371;* Chatham, *Harriet Wheeler* (CU); North Chatham, *House 21326;* Bashbish Falls, *Knowlton & Schweinfurth* (NEBC); Pine Plains, *Hoysradt* (CU, NY*). Also known from Clermont and Kinderhook.

C. **laxiculmis** Schwein. Dry woodlands; rather frequent eastward, but not reported from the Hudson Valley. Lebanon Springs, *Harriet Wheeler* (CU); Mount Lebanon, *House 16143;* Ancram Lead Mines (Ancramdale), *Peck*;* Pine Plains, *Hoysradt* (NY*).

C. **laxiflora** Lam. Woods, often in rich soil; widely distributed. Mount Lebanon, *House 16134;* Pine Plains, *Hoysradt* (NY*); Blue Hill, Livingston, *House 22702;* ½ mile southeast of Clermont, *3229.*

C. **leptonervia** (Fern.) Fern. Rocky woods; confined, so far as known, to the eastern part of the area. "Columbia Falls," Austerlitz, *Harriet Wheeler,* May 16, 1901 (CU); Bashbish Gorge, according to Knowlton (1919); Canaan, *4257.*

C. **albursina** Sheldon. Rich woodlands. New Lebanon, *House 21290;* Queechy Lake, *Harriet Wheeler* (CU); Ancram Lead Mines (Ancramdale), *Peck*;* reported by Hoysradt from Pine Plains (as *C. laxiflora* var. *latifolia*). Not reported from the Hudson Valley.

C. **blanda** Dew. Rich woodlands; frequent. Apparently the most abundant species of the section *Laxiflorae,* except in the higher hills to the eastward, where it is unknown. East Greenbush, *House 13898*;* Ancram Lead Mines (Ancramdale), *Peck*;* Chatham, *Harriet Wheeler* (CU); North Chatham, *House 21336;* Kinderhook, *659;* Hudson, east of Mount Merino, *House 22639;* Rhinecliff, Dutchess County, *House 19288.*

C. **gracilescens** Steud. Woodlands and moist thickets; unknown except in the Hudson Valley. North Chatham, *House 21330;* Poelsburg, *577;* Pine Plains, *Hoysradt* (NY*); New Forge, *4398.*

Section 18. **Granulares**

1. Perigynia elliptic-obovoid, 2 to 2.25 mm. long, 1 to 1.5 mm. wide, ascending, not ventricose-squarrose, rounded at the apex, abruptly minutely beaked *C. Haleana*

1. Perigynia broadly ovoid to broadly obovoid, 2.5 to 4 mm. long, 1.5 to 2.5 mm. wide, soon ventricose-squarrose, tapering at the base, minutely beaked *C. granularis*

C. **Haleana** Olney (*C. granularis* var. *Haleana* of *Gray's Manual*). Moist meadows. Lebanon Springs, *Harriet Wheeler* (CU); Ancram Lead Mines (Ancramdale) *Peck*;* 1.5 miles south of Ancramdale, *3385.*

C. granularis Muhl. Moist meadows; frequent. New Lebanon, *House 21287;* Chatham, *Harriet Wheeler* (CU); Pine Plains, *Hoysradt* (NY*); east of Blue Hill, *House 22694.*

Section 19. **Oligocarpae**

1. Bract sheaths glabrous, the lower 0.6 to 2 cm. long; perigynia 4 mm. long or less; leaf blades 2 to 4.5 mm. wide; culms reddish-tinged at the base *C. oligocarpa*

1. Bract sheaths strongly hispidulous, the lower 2 to 6 cm. long; perigynia 4.5 to 5 mm. long; leaf blades 3 to 7 mm. wide; culms brownish-tinged at the base *C. Hitchcockiana*

C. oligocarpa Schkuhr. Dry rocky woods; apparently rare. Pine Plains, Little Stissing Mountain, *Hoysradt* (CU, NY*).

C. Hitchcockiana Dew. Pine Plains, *Hoysradt* (CU). There is also a specimen in the Boott Herbarium in the New York Botanical Garden, marked "fr. L. H. Hoysradt no. 77."* Otherwise unknown.

Section 20. **Griseae**

1. Perigynia elliptic, 1.5 mm. wide; bract sheaths minutely serrulate on the edges; peduncles of pistillate spikes rough; leaf blades 2 to 4 mm. wide *C. conoidea*

1. Perigynia oblong-oval to broadly obovoid, 2 to 2.5 mm. wide; bract sheaths glabrous; peduncles of pistillate spikes smooth or nearly so; leaf blades 2 to 18 mm. wide, *2*

2. Pistillate spikes 3- to 12-flowered; leaves slightly if at all glaucous, thin and soft; bract sheaths tight *C. amphibola*

2. Pistillate spikes 15- (rarely 12-) to 35-flowered; leaves very glaucous, thick and firm; bract sheaths enlarged upward *C. glaucodea*

C. conoidea Schkuhr. Moist meadows; frequent or common in the Hudson Valley and adjacent uplands, but unknown from elevations above 300 m. New Lebanon, *House 21276;* Brainard, *House 21372;* North Chatham, *House 21339;* New Baltimore, *Peck**; Blue Hill, *House 22691;* 1 mile south of Germantown, *3313;* "Silvernail Bridge meadow" (Silvernails), *Hoysradt* (NY*). Also known from New Forge, Ghent, Mellenville and Clermont.

C. amphibola Steud. Moist or dry thickets; rather frequent in the Hudson Valley, but not reported from the eastern tier of towns. Brainard, *House 21376;* North Chatham, *House 21328;* Chatham, *Harriet Wheeler* (CU); 2.5 miles west of Clermont, *3268;* Rogers Island, *2573* (PENN); Pine Plains, *Hoysradt* (NY*). The usual representative of this species in eastern New York is var. **turgida** Fern.

C. glaucodea Tuckerm. (*C. flaccosperma,* var. *glaucodea* of *Gray's Manual*). Stissing Mountain, *Hoysradt* (CU, NY*), *Peck**; Curtis Mountain, Nassau, *House 21486.*

Section 21. **Gracillimae**

1. Sheaths (except the lower which are dorsally somewhat hispidulous) and leaves glabrous, *2*

2. Bracts long-sheathing; perigynia bluntly angled, obtuse at the apex *C. gracillima*

2. Bracts sheathless; perigynia sharply angled, tapering into a triangular, often twisted beak nearly as long as the body *C. prasina*

1. Sheaths and often the leaf blades pubescent, *3*

3. Spikes usually all gynaecandrous; pistillate scales except the lowest obtuse or acute; perigynia 2-ribbed and obscurely nerved, 1.75 to 2 mm. wide *C. formosa*
3. Lateral spikes pistillate; pistillate scales obtuse to long-cuspidate, *4*
  4. Perigynia 2 to 2.5 mm. wide, inflated, strongly nerved; leaf blades 3 to 8 mm. wide *C. Davisii*
  4. Perigynia about 1 mm. wide, not inflated, 2-ribbed and obscurely nerved; leaf blades 1.5 to 2.5 mm. wide *C. aestivalis*

C. **gracillima** Schwein. Moist or rocky woods and meadows; common. New Lebanon; Canaan; 2 miles south-southwest of Green River; 2 miles southeast of Hillsdale; Brainard; Malden Bridge; Kinderhook; Hudson; Blue Hill; Pine Plains.

C. **prasina** Wahlenb. Moist places; rather frequent eastward, but less so in the Hudson Valley. New Lebanon, *House 21280;* East Chatham, *Harriet Wheeler* (CU); 2 miles north of Mellenville, *4364;* Clermont, *4340;* 2 miles southwest of Green River, *3517;* Pine Plains, *Hoysradt* (CU, NY*).

C. **formosa** Dew. "Woods and thickets, in calcareous districts . . . local . . ." (N. Am. Flora 18: 280. 1935). Known in our area only from Ancram Lead Mines (Ancramdale), *Peck**; and from Pine Plains, *Hoysradt* (CU, NY*).

C. **Davisii** Schwein. & Torr. "Alluvial woodlands, mostly in calcareous districts" (N. Am. Flora 18: 281. 1935). Greenbush, *Peck*;* Rogers Island, *2570;* Pine Plains, *Hoysradt* (CU, NY*). The Hoysradt plant in New York is labeled "Jansen Kill," which probably means it was collected in the town of Gallatin.

C. **aestivalis** M. A. Curtis. Rocky woods at the higher elevations eastward and northeastward; otherwise unknown. Stephentown, *E. G. Whitney 2893* (CU); Bashbish Falls, *N. L. Britton* (CU); Mount Riga, town of Northeast, *Hoysradt* (NY*).

Section 22. Sylvaticae

1. Perigynia sessile or substipitate; scales obtuse to short-acuminate, usually half the length of the perigynia or less; achenes conspicuously stipitate; broadest basal leaves 2 to 4.5 mm. wide *C. debilis*
1. Perigynia strongly stipitate; scales cuspidate or awned, usually more than half the length of the perigynia; achenes substipitate or sessile; broadest basal leaves 5 to 10 mm. wide *C. arctata*

C. **debilis** Michx. Rocky woods, on schistose and quartzitic soils, in the southeastern part of our area. Pine Plains, *Hoysradt* (NY*); "Lake Undine, near Bashbish Falls," *N. L. Britton,* Aug 5, 1900 (CU); Brace Mountain, *House 24802.* Represented in our area only by var. **Rudgei** Bailey.

C. **arctata** Boott. Rocky woods; frequent eastward, at elevations over 300 meters. Unknown in the Hudson Valley. Mount Lebanon, *House 15596**; 2 miles south of Flatbrook, *3603;* 2 miles east of Austerlitz, *702* (NYS, PENN); Mount Riga, *Hoysradt* (NY*); a specimen collected by Hoysradt, now at Cornell University, may be from the vicinity of Pine Plains.

Section 23. Longirostres

C. **Sprengelii** Dew. Pine Plains, *Hoysradt* (CU, NY*); grassy bank of Kinderhook Creek near Kinderhook, *4405.* Otherwise unknown.

Section 24. Extensae

1. Perigynia 2 to 3 mm. long, little if at all deflexed, the beak much shorter than the body; spikes oblong, 4 to 7 mm. wide, *2*
   2. Spikes 2 to 7, the lower often separate, the terminal usually staminate, conspicuous; pistillate scales usually reddish-tinged; plants fruiting from May to July *C. viridula*
   2. Spikes 4 to 15, mostly densely aggregated, the terminal usually androgynous with the staminate portion very small and inconspicuous; pistillate scales usually very slightly if at all reddish-tinged; plants fruiting from July to September *C. viridula* f. *intermedia*
1. Perigynia 3.5 to 6 mm. long, at least the lower conspicuously deflexed, the beak equaling the body; spikes subglobose, 7 to 12 mm. wide, *3*
   3. Perigynia 3.5 to 4.5 mm. long, the beak smooth, pale at the tip; scales slightly if at all reddish-tinged, largely concealed by the perigynia; leaf blades 1 to 3 mm. wide *C. cryptolepis*
   3. Perigynia 4.5 to 6 mm. long, the beak serrulate, reddish-tinged, conspicuous in the spikes; leaf blades 3 to 5 mm. wide *C. flava*

C. viridula Michx. Pine Plains, cold shores of Bry. Hoysradt's sunken marsh, *Hoysradt* (NY; determined by Mackenzie as *C. Oederi*).

Forma **intermedia** (Dudley) F. J. Herm. Calcareous meadows; apparently rare. Queechy Lake, *Harriet Wheeler* (CU); Pine Plains, *Hoysradt* (CU).

C. cryptolepis Mackenz. *(C. flava* var. *fertilis* of *Gray's Manual).* Wet meadows, usually in calcareous marshes. Waldorf Pond, *House 20945;* 3 miles north of Ancramdale, *3345.*

C. flava L. Rich or calcareous meadows; rather frequent eastward in the calcareous regions of the Harlem Valley and in New Lebanon and Canaan. Infrequent elsewhere. New Lebanon, *House 21277;* Queechy Lake, *Harriet Wheeler* (CU); 1 mile south of Canaan, *742;* Millerton, *Peck*;* Pine Plains, *Hoysradt* (CU, NY*); 1 mile south of Germantown, *3314.*

Section 25. Virescentes

1. Terminal spike staminate *C. pallescens*
1. Terminal spike gynaecandrous, *2*
   2. Perigynia densely pubescent; spikes about 3 to 4 mm. thick, the lower more or less widely separated and peduncled, *3*
      3. Pistillate spikes oblong or oblong-globose, abrupt or rounded at the base, the lowest 5 to 20 mm. long; anthers 0.8 to 1.6 mm. long *C. Swanii*
      3. Pistillate spikes linear, attenuate at the base, the lowest 15 to 40 mm. long; anthers 1.5 to 2.5 mm. long *C. virescens*
   2. Perigynia glabrous; spikes 4 to 8 mm. thick, contiguous or nearly so, sessile or subsessile, *4*
      4. Perigynia more or less flattened ventrally, rounded at the apex, nerved, 2 to 2.5 mm. long; achenes with a somewhat bent short-apiculate tip, *5*
         5. Leaf blades glabrous or nearly so, stiff, with revolute margins *C. complanata*
         5. Leaf blades conspicuously short-pubescent, flat, not stiff *C. hirsutella*
      4. Perigynia turgid, nearly round in cross section, short-pointed at the apex, coarsely nerved or ribbed, 2.5 to 3.5 mm. long; achenes with a very abruptly bent apiculate tip or style *C. Bushii*

C. **pallescens** L. Meadows and dry banks; rather frequent. Not reported from the higher elevations. New Lebanon, *House 21285;* Douglas Knob, Canaan, *3622;* Boston Corners, *Hoysradt* (NY*); 1 mile south of Germantown, *3311.* The American representative of this species has been called var. **neogaea** Fern.

C. **Swanii** (Fern.) Mackenz. Dry woods and thickets; rather frequent. Stephentown, *House 22826;* Lebanon Springs, *Harriet Wheeler* (CU); Stissing Mountain, *Peck*;* 2 miles south of Claverack, *3990.*

C. **virescens** Muhl. Dry woods and thickets; apparently infrequent. Pine Plains, *Hoysradt* (CU, NY*); New Forge, *3472;* Brace Mountain, *House 24828.*

C. **complanata** Torr. & Hook. Pine Plains, *Hoysradt* (NY*). Otherwise unknown.

C. **hirsutella** Mackenz. Dry woods and thickets, or in the open; common. Lebanon Springs; Green River; Copake; Stissing Mountain; Brainard; Kinderhook; Hudson; Blue Stores; Germantown; Elizaville.

C. **Bushii** Mackenz. Rich meadowlands; infrequent. Unknown eastward. Blue Hill, *House 22696;* 0.5 mile west of Brainard, *House 21370;* 1 mile south of Germantown, *3318;* Rhinecliff, *House 19282.*

Section 26. Hirtae

1. Leaf blades flat, 2 to 5 mm. wide; culms sharply triangular; achenes straight-apiculate *C. lanuginosa*
1. Leaf blades involute-filiform, 2 mm. wide or less; culms obtusely triangular; achenes bent-apiculate *C. lasiocarpa*

C. **lanuginosa** Michx. Moist meadows and swamps; known only from the Hudson Valley, where frequent. North Chatham, *House 21325;* Kinderhook, *2532* (PENN); Blue Hill, *House 22695;* 1 mile east of Clermont, *3251;* Pine Plains, *Hoysradt* (CU, NY*).

C. **lasiocarpa** Ehrh. Swampy places, usually in sphagnum bogs. 3 miles southeast of Harlemville, *1131;* 1 mile south of Taghkanic Lake, *House 20519;* Pine Plains, *Hoysradt* (CU, NY*). The American representative of this species has been called var. **americana** Fern.

Section 27. Anomalae

C. **scabrata** Schwein. Swampy woodlands; rather frequent eastward, but unknown from the Hudson Valley. New Lebanon, *House 21279;* 1 mile south of Canaan Center, *3616;* 2 miles south-southwest of Green River, *3519;* 4 miles southeast of Spencertown, *1860;* Pine Plains, *Hoysradt* (CU, NY*).

Section 28. Limosae

C. **limosa** L. Sphagnum bogs; infrequent. Sand Lake, *Peck*;* bog southeast of Knickerbocker Lake, *1023;* Pine Plains, *Hoysradt* (CU, NY*).

Section 29. Atratae

C. **Buxbaumii** Wahlenb. In swamps; rare and local. Bog in White Mills Woods, Chatham, *Harriet Wheeler* (CU); Pine Plains, peat bogs, *Hoysradt* (CU, NY*).

Section 30. Acutae

1. Beak of perigynium very short, or absent, not twisted; pistillate spikes erect, *2*

2. Culms strongly phyllopodic; fertile culms surrounded at the base by the dried-up leaves of the previous year, *3*
   3. Perigynia conspicuously nerved ventrally; culms single or in small clumps, strongly stoloniferous *C. nigra*
   3. Perigynia nerveless ventrally; culms densely caespitose, not stoloniferous *C. substricta*
2. Culms aphyllopodic; fertile culms arising laterally and not surrounded at base by the tufts of leaves from the previous year, *4*
   4. Leaf sheaths hispidulous, usually with a minute erose-ciliate margin at the mouth; leaves usually pale green or glaucous *C. stricta* var. *strictior*
   4. Leaf sheaths glabrous ventrally, without a minute erose-ciliate margin at the mouth; leaves dark green *C. stricta*

1. Beak of perigynium prominent, twisted when dry; at least the lower pistillate spikes nodding or recurved *C. torta*

C. nigra (L.) Reichard. "Wet meadows near the coast, Greenland to Rhode Island" (N. Am. Flora 18: 392. 1935). Not reported in this publication from New York, but a specimen in the New York Botanical Garden, collected at Pine Plains by Hoysradt in July 1875, was determined by Mackenzie and later was examined by F. J. Hermann, who confirmed this determination.

C. substricta (Kükenth.) Mackenz. (*C. aquatilis,* var. *altior* of *Gray's Manual*). Calcareous marshes. Miller Pond, Ancram, *3116;* Pine Plains, *Hoysradt* (NY*); reported by Hoysradt (1875-79) from "Drowned Lands above Halstead Station" (in Ancram, about 2 miles northeast of Ancramdale).

C. stricta Lam. Wet places; common. Locally very abundant and forming large tussocks ("bogs").

Var. **strictior** (Dew.) Carey. Wet grassy places. New Lebanon, *House 21274;* 2 miles north of Canaan, *1267.*

C. torta Boott. Wet places; often in rocky stream beds; rather frequent eastward. Rare or local in the Hudson Valley. New Lebanon, *House 21289;* East Chatham, *Harriet Wheeler* (CU); "Columbia Falls, Austerlitz," *Harriet Wheeler* (CU); Bashbish Brook, *Knowlton & Schweinfurth* (NEBC); Stissing Mountain, *Hoysradt* (NY*); Waldorf Pond, *House 21148;* Arnold's Mill, Kline Kill, *4106;* 2 miles northeast of Chatham, *4170.*

Section 31. Cryptocarpae

1. Sheaths rough-hispidulous; lower pistillate scales rounded to truncate or tapering into the awn *C. gynandra*
1. Sheaths smooth; lower pistillate scales emarginate, abruptly contracted into the awn *C. crinita*

C. gynandra Schwein. (*C. crinita* var. *gynandra* of *Gray's Manual*). Swampy places; distribution not well-known. 1.5 miles southeast of Clermont, *3231;* 2 miles east of Elizaville, *3200.*

C. crinita Lam. Swampy places and stream banks; common. New Lebanon, *House 21272;* New Forge, *3491;* 1 mile north of Kinderhook, *976* (NYS, PENN); Hotaling Island, *3132*; Rogers Island, *2558*; Pine Plains, *Hoysradt* (CU, NY*).

Section 32. Pseudo-Cypereae

1. Teeth of perigynia not over 0.5 mm. long; perigynia suborbicular in cross section, more or less inflated, membranaceous; ligule not longer than wide, *2*

2. Staminate scales cuspidate to acute; pistillate spikes linear-cylindric *C. Schweinitzii*
2. Staminate scales with rough awns; pistillate spikes oblong or oblong-cylindric *C. hystricina*
1. Teeth of perigynia 0.5 mm. long or more; perigynia flattened-triangular, scarcely inflated, coriaceous; ligule much longer than wide, *3*
3. Teeth of perigynia recurved-spreading, 1.2 to 2 mm. long; beaks of perigynia (exclusive of the teeth) 1.5 to 2.2 mm. long, equaling or longer than the bodies; perigynia 6 mm. long *C. comosa*
3. Teeth of perigynia erect or slightly spreading, 0.5 to 1 mm. long; beaks of perigynia (exclusive of the teeth) averaging 1 mm. long, shorter than the bodies; perigynia 4 to 5 mm. long *C. Pseudo-Cyperus*

C. Schweinitzii Dew. "Swamps or springy banks in calcareous districts . . . A very local species" (N. Am. Flora 18: 430. 1935). Pine Plains, *Hoysradt* (CU, NY*). Otherwise unknown.

C. hystricina Muhl. Swampy places; apparently infrequent. 1 mile south of Germantown, *3315;* Pine Plains, *Hoysradt* (NY*).

C. comosa Boott. Wet places; common.

C. Pseudo-Cyperus L. Marshes around Knickerbocker Lake, *1197* (NYS, PENN); [Pikes' Pond, *House 21961*]. Otherwise unknown.

Section 33. **Paludosae**

1. Beaks of perigynia much shorter than the bodies, the teeth short, about 0.5 mm. long, erect or nearly so; foliage glabrous *C. lacustris*
1. Beaks of perigynia (including the teeth) nearly as long as the bodies, the teeth prominent, 1 to 3 mm. long, erect to widely spreading, *2*
2. Perigynia glabrous; leaf sheaths pubescent; at least the lower leaf blades sparsely hairy below toward the base *C. atherodes*
2. Perigynia hairy; leaf sheaths and blades glabrous *C. trichocarpa*

C. lacustris Willd. Open grassy marshes, especially in calcareous situations; rather frequent in the Hudson and Harlem Valleys. Unknown elsewhere. 3 miles north of Ancramdale, *803;* North Chatham, *House 21170;* bog 1 mile south of Hemlock School, Ghent, *564;* Kinderhook, *959;* Rogers Island, *2587.*

C. atherodes Spreng. Known only from a small pond south of Miller Pond, Ancram, *House 20537.*

C. trichocarpa Muhl. Wet meadows; apparently infrequent. Unknown eastward. Pine Plains, *Hoysradt* (NY*); 1.5 miles southeast of Clermont, *3228;* Hotaling Island, *3154.*

Section 34. **Squarrosae**

C. squarrosa L. Wet meadows; infrequent, but widely distributed in the Hudson and Harlem Valleys. Unknown northeastward. Robinson Pond, *House 20618;* 0.5 mile west of Brainard, *House 21379;* Mill Creek, Stuyvesant, *2527;* Rogers Island, *2571;* 2 miles south of Germantown, *3158;* Tivoli, *2675.*

Section 35. **Vesicariae**

1. Pistillate scales not rough-awned, *2*
2. Perigynia not reflexed; bracts moderately exceeding the inflorescence, *3*
3. Achenes not excavated on one side; perigynia 2.5 to 3.5 mm. wide, *4*

4. Culms sharply triangular below the spike, rough; perigynia appressed or ascending; teeth of perigynia long, or the perigynia tapering into the beak; ligule much longer than wide *C. vesicaria*
4. Culms bluntly triangular below the spikes, smooth; perigynia spreading or squarrose at maturity; teeth of perigynia short, or the perigynia abruptly beaked; ligule slightly if at all longer than wide *C. rostrata*
3. Achenes deeply excavated on one side; perigynia 5 to 6.5 mm. wide *C. Tuckermani*
2. Lower perigynia reflexed or widely spreading, somewhat falcate; bracts many times exceeding the inflorescence *C. retrorsa*
1. Pistillate scales rough-awned *C. lurida*

C. vesicaria L. Swampy places; apparently infrequent. Southeast of Brainard, *House 21531;* Pine Plains, *Peck* (NYS,* NY*); Pine Plains, *Hoysradt* (CU, NY*); Stissing Mountain, *Hoysradt* (NY*).

C. rostrata Stokes. Swampy places; frequent. Unknown northeastward. Pine Plains, *Hoysradt* (CU, NY*); 3 miles north of Ancramdale, *3347, 3403;* 3 miles southeast of Harlemville, *1132* (NYS, PENN); 2 miles southeast of Taghkanic, *3360;* 1 mile south of Tivoli, *2664* (PENN).

C. Tuckermani Boott. Open swampy places and wet woods; infrequent. "Jansen Kill, below Ancram," *Hoysradt* (NY*); Chatham, *Harriet Wheeler* (CU); Bells' Pond, Livingston, *3306;* 1.5 miles southeast of Clermont, 3223.

C. retrorsa Schwein. Swampy places; rather frequent in the Hudson and Harlem Valleys. Unknown at higher elevations eastward and northeastward. Pond south of Miller Pond, Ancram, *House 20539;* Robinson Pond, *3930;* Pine Plains, *Hoysradt* (CU, NY*); Kinderhook Lake, *House 21444;* along Hudson River at New Baltimore, *House 21624.*

C. lurida Wahlenb. Wet places; very common.

Section 36. Lupulinae

1. Pistillate spikes globose to short-ovoid; style straight or the bend remote from the achene, *2*
2. Perigynia radiating in all directions, cuneate at the base, subcoriaceous, usually somewhat hispidulous; staminate spike subsessile or short-peduncled; achenes obscurely trigonous, almost suborbicular in cross section, the angles inconspicuous *C. Grayii*
2. Perigynia ascending, rounded at the base, membranaceous, smooth and shining; staminate spike normally long-peduncled; achenes with blunt angles but conspicuously trigonous *C. intumescens*
1. Pistillate spikes oblong to cylindric; style abruptly bent immediately above the achene *C. lupulina*

C. Grayii Carey. Wet woods, usually in alluvial soil; frequent in the Hudson Valley. Unknown elsewhere. New Baltimore, *E. C. Howe*;* Poelsburg, *892;* Nutten Hook, *2221;* Rogers Island, *2555;* 1.5 miles southeast of Clermont, *3224;* 2 miles east of Germantown, *2936.*

C. intumescens Rudge. Swampy woods; common.

C. lupulina Muhl. Swampy places; common in the Hudson and Harlem Valleys; unknown at the higher elevations eastward and northeastward. Pond south of Miller Pond, Ancram, *House 20538;* Long Pond, Ancram, *3440;* Pine Plains, *Hoysradt* (NY*); Kinderhook Lake, *C. A. Brown 99;* Fowlers' Lake, *1676;* Rogers Island, *2593;* 2 miles west of Nevis, *2890;* Chatham, *Harriet Wheeler* (CU).

Figure 9. Sand flats just north of Nutten Hook. The ground cover is *Triplasis purpurea.*

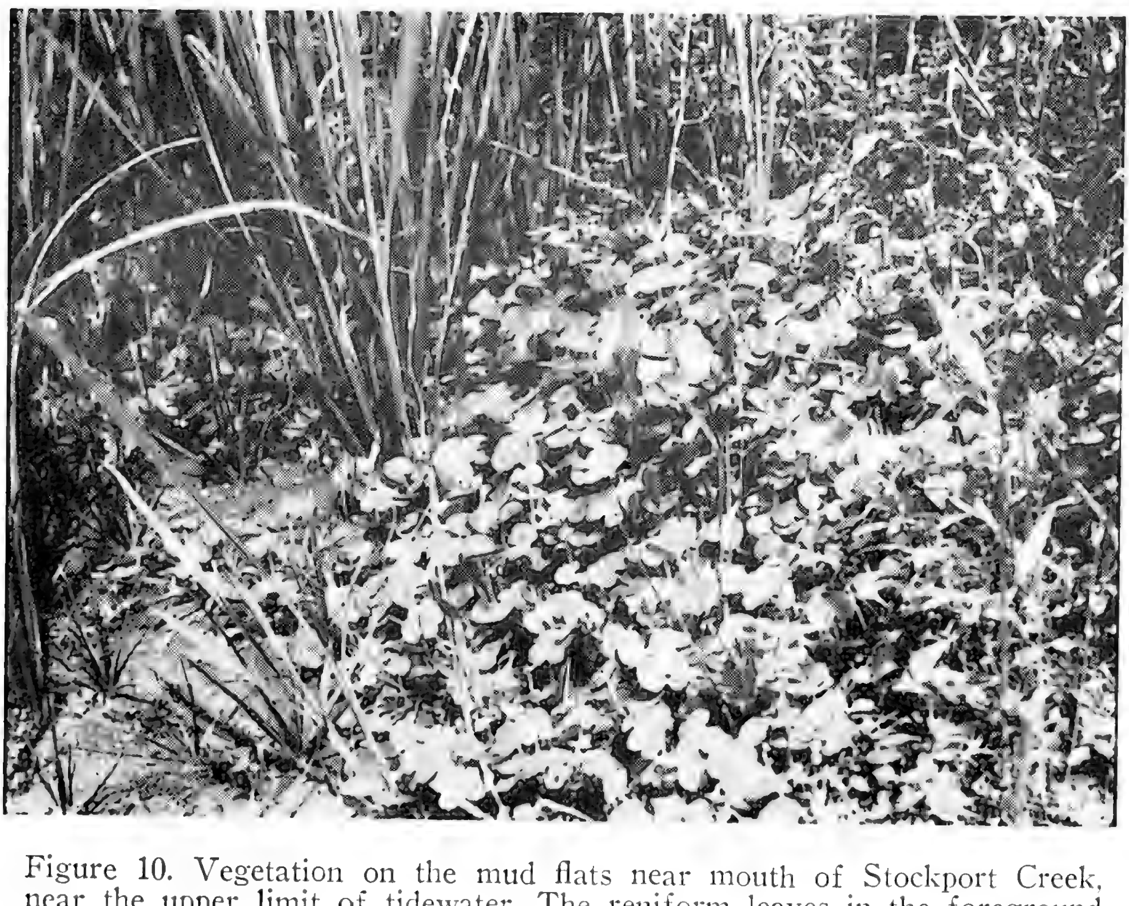

Figure 10. Vegetation on the mud flats near mouth of Stockport Creek, near the upper limit of tidewater. The reniform leaves in the foreground are those of *Heteranthera reniformis.*

Figure 11. A large flowering specimen of *Habenaria psycodes* in a swampy woods about 1 mile north of Kinderhook.

Figure 12. *Spiranthes cernua* in a sphagnum bog west of Post Road School, Kinderhook. The small-leaved shrub at left is *Potentilla fruticosa*.

ARACEAE (Arum Family)

1. Spadix subtended by a leafy or fleshy spathe; leaves broad, not linear, *2*
2. Spadix globose, appearing with the nearly sessile reddish or purplish streaked spathe in earliest spring, much before the leaves; plants with strong skunklike odor 4. **Symplocarpus**
2. Spadix cylindric or elongated; spathe borne on a peduncle, appearing when the leaves are grown, *3*
3. Spathe spreading, not surrounding the short-cylindric spadix, its upper surface white 3. **Calla**
3. Spathe surrounding the elongated spadix, *4*
4. Flowers covering the base of the spadix only; leaves not sagittate 1. **Arisaema**
4. Flowers covering the entire spadix; leaves sagittate 2. **Peltandra**
1. Spadix cylindrical, without obvious spathe, *5*
5. Spadix terminating the scape; flowers golden yellow; leaves elliptic, not wetted by water 5. **Orontium**
5. Spadix lateral; flowers green; leaves linear, cattail-like; rootstocks and whole plant aromatic 6. **Acorus**

1. **Arisaema** Mart.

1. Leaflets 3; spathe hooded, the hood 2 to 5 cm. wide; spadix blunt at tip, *2*
2. Leaves glaucous beneath; tube of spathe not fluted, usually indistinctly striped *A. triphyllum*
2. Leaves green beneath; tube of spathe fluted, with longitudinal green and white stripes *A. Stewardsonii*
1. Leaflets 7 to 11; spathe narrow, often twisted; spadix with a long slender point *A. Dracontium*

A. triphyllum (L.) Schott. (*A. atrorubens* of *Gray's Manual*). "Jack-in-the pulpit," "Indian turnip." Moist woods; common throughout.

A. Stewardsonii Britt. Moist or swampy woods; local, but more abundant eastward than in the Hudson Valley. Bog west of Douglas Knob, New Lebanon, *2117* (PENN); 1 mile east of Canaan Center, *2322;* Millerton, *House 22398;* 1 mile southwest of Clermont, *3265;* Rogers Island, *2543;* New Britain, *4303.*

A. Dracontium (L.) Schott. Green dragon. Wet woods; rare and local. New Forge, along Taghkanic Creek, *3484;* Hotaling Island, Greene County, *3136.* Reported from Hudson (Stebbins, 1830) and from Silvernail Falls (Hoysradt, 1875-79).

2. **Peltandra** Raf.

P. virginica (L.) Kunth. Green water arum. Wet places and swamps, including sphagnum bogs; very abundant in tidal mud along the Hudson, and decreasing eastward. Unknown from the higher elevations. North Chatham, *House 20479;* 3 miles north of Ancramdale, *1078;* bog southeast of Knickerbocker Lake, *1157;* Hudson, *1106;* Rogers Island, *2544.*

3. **Calla** L.

Calla palustris L. Wild calla. Swampy woods; rare and local. 2 miles southeast of Stuyvesant Falls, *1386*; Canticoke Swamp, Nassau, *1716*; New Britain, *3644;* south of North Nassau, *House 23700.* Abundant in the above localities.

4. **Symplocarpus** Salisb.

S. foetidus (L.) Nutt. "Skunk cabbage." Swampy places and wet woods;

abundant throughout most of the county, but not recorded from elevations of more than 300 m.

5. **Orontium** L.

O. aquaticum L. Goldenclub. Tidal mud along the Hudson River, there locally very abundant. Otherwise unknown. Swampy flats south of Stockport Station, *525;* Rogers Island, *2542;* Hudson, *Muenscher & Clausen 4431* (CU); Nutten Hook, *Muenscher & Clausen 5015* (CU).

6. **Acorus** L.

A. Calamus L. Sweetflag, Calamus. Ditches, wet or swampy places; common in the Hudson Valley. Infrequent eastward; not reported from above 300 m. elevation. Pond south of Miller Pond, Ancram, *House 20541;* Malden Bridge, *907;* 2 miles east of Kinderhook, *1482;* Nutten Hook, *864;* Rogers Island, *2546.* [Also observed at Brainard; Kinderhook Lake; near Germantown; Hillsdale; Copake; east of Blue Hill and New Britain.]

LEMNACEAE (Duckweed Family)

1. Fronds flat, each with one to several rootlets, *2*
  2. Fronds purple beneath, 5- to 15-nerved, each with several rootlets 1. **Spirodela**
  2. Fronds green on both sides, 1- to 5-nerved, each with one rootlet 2. **Lemna**
1. Fronds thick, ovoid, ellipsoid or globular, without rootlets, 0.7 to 1.5 mm. long 3. **Wolffia**

1. **Spirodela** Schleid.

S. polyrhiza (L.) Schleid. Large duckweed. Floating on ponds and quiet streams; frequent. Kinderhook Lake, *House 15550;* Bachus Pond, *918;* Waldorf Pond, *3177*; Robinson Pond, *House 20620.* Seen also at Fowlers' Lake and at New Britain.

2. **Lemna** L.

1. Fronds oblong, long-stalked at base, remaining connected in chains, wholly submerged *L. trisulca*
1. Fronds nearly circular to obovate in outline, not stalked, soon separating, floating on the surface *L. minor*

L. trisulca L. Floating in ponds and quiet streams; local. Waldorf Pond, *3176;* Fowlers' Lake, *2394;* Kinderhook Lake, *Muenscher & Clausen 4437* (CU); Pine Plains, *Hoysradt* (MICH).

L. minor L. Floating on quiet water; common throughout.

3. **Wolffia** Horkel

W. columbiana Karst. Floating in quiet water in small ponds; very local. Abundant at a bog at New Britain, *4296,* and a small pond 2 miles west of Greendale, *4324.*

XYRIDACEAE ("Yellow-eyed grass" Family)

Xyris L. "Yellow-eyed grass"

1. Spike narrowly ovoid, 5 to 10 mm. long by 5 to 10 mm. thick, at maturity chestnut-colored *X. montana*
1. Spike narrowly ovid, 7 to 12 mm. long by 5 to 8 mm. thick, at maturity greenish or pale brown *X. caroliniana*

X. montana Ries. Well known in northern New York, and at Sand Lake, Rensselaer County, *Peck.*

X. caroliniana Walt. Sphagnum bogs; rare. Bog southeast of Knickerbocker Lake, *2147;* "Fingar Marsh," town of Gallatin, *3579.* The last locality was known to Hoysradt, who reported the species as "frequent" at Pine Plains.

ERIOCAULACEAE (Pipewort Family)

Eriocaulon L. Pipewort

1. Heads when mature white-hairy at summit; involucral bracts at maturity spreading or reflexed, the head hemispherical or nearly spherical *E. septangulare*

1. Heads never white-hairy; involucral bracts closely appressed even at maturity, the head depressed-hemispheric and the involucre short-campanulate *E. Parkeri*

E. septangulare With. Shallow water, margins of ponds; frequent. Sometimes emersed, on muddy shores, or in sphagnum bogs. No Bottom Pond; Taghkanic Lake; Forest Lake; pond south of Taghkanic Lake (PENN); Miller Pond, Stissing Mountain.

E. Parkeri Robins. Tidal mud along the Hudson Aiver, otherwise unknown. First reported from our area by Svenson (Torreya 35: 119. 1935), who found it in the town of Red Hook, at the mouth of Stony Creek. Poelsburg, *3807;* shore east of Rogers Island, *2958.*

COMMELINACEAE (Spiderwort Family)

Commelina L.

C. communis L. Asiatic dayflower, wandering Jew. Dry soil, weedy. Locally established in the Hudson Valley. Nutten Hook, *1456;* south of Kinderhook, *4025.*

PONTEDERIACEAE (Pickerelweed Family)

1. Plants tall, erect, with a dense many-flowered spike of purplish blue flowers; stamens 6; leaf blades cordate-ovate, elongate 1. **Pontederia**

1. Plants submerged, floating or low-growing on mud; flowers 1 to few from a spathe; stamens 3 2. **Heteranthera**

1. Pontederia L.

P. cordata L. Pickerelweed. Borders of streams and ponds; common in the Hudson Valley, especially in the estuary itself. Less common eastward, and unknown from above 300 m. elevation. Hotaling Island, *Taylor 1403* (NY); Merwins' Lake, *1241;* Fowlers' Lake, *717;* Taghkanic Lake, *2021;* North Bay, Tivoli, *2779.* Also reported (Muenscher, 1935, p. 232) from Tackawasick, Kinderhook, Queechy and Copake Lakes.

2. Heteranthera R. & P.

1. Plants growing on mud; leaves round-kidney-shaped to cordate; flowers white to pale blue *H. reniformis*

1. Plants wholly submerged, only the flowers reaching the surface; leaves linear, grasslike; flowers yellow *H. dubia*

H. reniformis R. & P. Common in tidal mud along the Hudson River; there abundant, locally forming large patches. Otherwise unknown. 2 miles north of Castleton, *3972;* Poelsburg, *3804;* Columbiaville, mouth of Stockport Creek, *3703*; flats between Hudson and Athens, *Muenscher & Clausen 4452* (CU); Rogers Island, *3742;* Crugers' Island, *2896;* South Bay below Hudson (Eaton, Man. ed. 3, 213. 1822) (figure 10).

H. dubia (Jacq.) MacM. Shallow water in ponds and streams; frequent. Queechy Lake; Kinderhook Lake; Roeliff Jansen Kill, 2 miles east of Germantown; Hudson; mouth of Stockport Creek; Spring Lake, Red Hook.

JUNCACEAE (Rush Family)

1. Capsule many-seeded; plants never hairy — 1. **Juncus**
1. Capsule containing three large seeds; plants hairy — 2. **Luzula**

1. Juncus L. Rush

1. Inflorescence appearing lateral, the involucral leaf erect and apparently a continuation of the naked scape, *2*
  2. Sepals rarely exceeding either the petals or the capsule, 2.5 to 3.5 mm. long — *J. effusus* var. *solutus*
  2. Sepals exceeding both petals and capsule, 2.7 to 4 mm. long — *J. effusus* var. *Pylaei*
1. Inflorescence terminal, *3*
  3. Leaves flat, or in age involute, or terete, but never hollow and septate, *4*
    4. Flowers borne singly on the branches of the inflorescence, not in heads; each flower with a pair of bracteoles at its base in addition to the bractlet at the base of the pedicel, *5*
      5. Inflorescence more than half the height of the plant; small annuals, with flowers scattered along the loose forking branches *J. bufonius*
      5. Inflorescence much less than half the height of the plant, *6*
        6. Leaf sheaths covering half the stem or more; perianth segments obtuse, incurved — *J. Gerardi*
        6. Leaf sheaths covering one-fourth the stem or less; perianth segments acute or acuminate, usually more or less spreading, *7*
          7. Leaves terete; capsule much exceeding the perianth, reddish or chestnut-colored — *J. Greenei*
          7. Leaves flat; capsule little if at all exceeding the perianth, green to straw-colored or dull brown, *8*
            8. Bracts shorter than the inflorescence; flowers conspicuously secund on the usually incurved branches — *J. secundus*
            8. Bracts (at least the lowermost) exceeding the inflorescence; flowers not conspicuously secund, *9*
              9. Auricles at the summit of the leaf sheaths very thin, white and scarious, conspicuously produced beyond the point of insertion, 1 to 3.5 mm. long — *J. tenuis*
              9. Auricles at the summit of the leaf sheaths firm, cartilaginous, yellow, brown with age, very rigid and glossy, not conspicuously produced beyond the point of insertion — *J. tenuis* var. *Dudleyi*
    4. Flowers in heads of 5 to 10 flowers each, not bracteolate at base — *J. marginatus*
  3. Leaves terete, hollow, septate, the septa felt as hard knots at regular intervals when a leaf is pulled between the fingers, *10*
    10. Seeds with definite tail-like appendages at the tips, *11*

11. Flowers 5 to 50 in a head, those with mature fruit about 4 mm. long; capsule equaling or moderately exceeding the perianth; seeds, including tails, 1 to 1.8 mm. long, with conspicuous tails; perianth segments subulate-tipped *J. canadensis*

11. Flowers 3 to 7 in a head, those with mature fruit 2.5 to 3.5 mm. long; capsule usually much exceeding the perianth; seeds, including tails, barely 1 mm. long, *12*

12. Perianth segments obtuse or essentially so; capsule ovate, gradually narrowed to the tip *J. brachycephalus*

12. Perianth segments acuminate; capsule oblong, abruptly acute at tip *J. brevicaudatus*

10. Seeds without tail-like appendages, blunt or short-pointed, *13*

13. Stamens 3, opposite the sepals, *14*

14. Capsule oblong, gradually attenuate, about twice the length of the perianth *J. diffusissimus*

14. Capsule ovoid, abruptly acute at tip, scarcely exceeding the perianth *J. acuminatus*

13. Stamens 6, *15*

15. Flowers solitary or in pairs, often reduced to fascicles of small leaves *J. pelocarpus*

15. Flowers numerous, in spherical or hemispherical heads, *16*

16. Involucral bract usually exceeding the inflorescence; capsule subulate; heads spherical, 7 to 15 mm. wide *J. nodosus*

16. Involucral bract shorter than the inflorescence; capsule ovoid, acute, not subulate; heads hemispherical, 6 mm. wide or less *J. articulatus*

J. **effusus** L., var. **solutus** Fern. & Wieg. Soft rush. Candle rush. Wet places; common throughout.

J. **effusus** L., var. **Pylaei** (Laharpe) Fern. & Wieg. Known only from a swampy meadow 1 mile west of Ancramdale, *3396.*

J. **bufonius** L. Moist places, roadsides, dooryards and along margins of streams; infrequent. Curtis Mountain, *House 21487;* roadside 3 miles north of Ancramdale, *3410;* Pine Plains, *Hoysradt* (MO); 1 mile south of Claverack, *2610* (PENN). Known also from Kinderhook Lake and Mount Lebanon (*House*).

J. **Gerardi** Loisel. "Black grass." A halophytic species known only from rocks in the bed of Kinderhook Creek at Stuyvesant Falls, *997.*

J. **tenuis** Willd. Moist or dry places, meadows and waste ground; common, often weedy.

Var. **Dudleyi** (Wieg.) F. J. Herm. (*J. Dudleyi* of *Gray's Manual*). Damp places, in neutral or calcareous soil; apparently rather frequent. 3 miles north of Ancramdale, *3405;* Magdalen Island, *2679* (PENN); mouth of Stony Creek, *Svenson 6027* (BKL).

J. **secundus** Beauv. Rocky or dry soil, or in clay, often apparently weedy; frequent. 2 miles south of Canaan, *3595;* Cedar Mountain, Copake, *3574;* Pine Plains, *Hoysradt* (CU); clay fields south of Columbiaville, *4039.*

J. **Greenei** Oakes & Tuckerm. Known only from the rocky summit of Washburn Mountain, Copake, at an elevation of about 450 m., *3328.*

J. **marginatus** Rostk. Moist meadows, apparently rather frequent. North Chatham, *House 20463;* 1 mile west of Ancramdale, *3395;* Pine Plains, *Hoysradt* (CU); 1 mile southeast of Glenco Mills, *4031.*

J. **diffusissimus** Buckl. Thompson Pond, Pine Plains, *Hoysradt,* Sept. 8, 1878 (MO); this is apparently the first New York record for this species. A

second specimen is from Lake Mahopac, Putnam County, *J. Carey* (MO).

J. pelocarpus Mey. Not seen in our area in recent years; "quite rare" at Pine Plains, according to Hoysradt (1875-79); Mount Riga, *Hoysradt* (CU); Plantain Pond, Mount Everett, *E. C. Townsend* (CU).

J. articulatus L. Wet places. Kinderhook Creek, south of Kinderhook, *1252;* East Nassau, *House 21944;* [Waldorf Pond, *House 23814*].

J. nodosus L. Wet meadows and swamps, especially in calcareous regions; rather frequent. Queechy Lake, *Harriet Wheeler* (CU); Copake Lake, *Harriet Wheeler* (CU); 3 miles north of Ancramdale, *3333, 3886;* Pine Plains, *Hoysradt* (CU).

J. brachycephalus (Engelm.) Buchenau. Wet meadows and shores, frequent. Very abundant in the calcareous marshes of the Harlem Valley. Waldorf Pond, *House 20942;* Copake Falls, *Britton et al.* (NY); Copake Falls, *3912;* 3 miles north of Ancramdale, *3885;* Pulvers Corners, *3846;* river shore east of Rogers Island, *2957* (PENN); mouth of Stony Creek, Red Hook, according to Svenson (1935).

J. canadensis J. Gay. Swamps and wet meadows; frequent. New Britain, *3650;* 0.5 mile northeast of Hillsdale, *3916;* Tackawasick Lake, *Muenscher & Clausen 4469* (CU); Knickerbocker Lake, *3826;* south of Kinderhook, *4027;* Pine Plains, *Hoysradt* (MO).

J. brevicaudatus (Engelm.) Fern. Wet meadows and shores, rather frequent. 2 miles south-southwest of Green River, *3533;* Forest Lake, *3769;* 1 mile southeast of Glenco Mills, *4030;* Pine Plains, in mountains, *Hoysradt* (MO); 1.5 miles north of Kinderhook, *3744.*

J. acuminatus Michx. Wet shores; common. Abundant on the tidal flats and in the marshes along the Hudson River.

2. Luzula DC.

1. Flowers solitary at the tips of the branches of the inflorescence *L. carolinae*
1. Flowers several together in dense clusters *L. multiflora*

L. carolinae S. Wats. (*L. acuminata* of *Gray's Manual*). Dry woods; locally abundant. Common or frequent eastward, at elevations of 300 m. or more. Rare or absent in the Hudson Valley. Lebanon Springs, *Harriet Wheeler* (CU); Mount Lebanon, *House 16136;* Perry Peak, Canaan, *House 21176;* west of Brainard, *House 21354;* 1 mile north of Riders Mills, *4066;* Copake Falls, *Burnham* (CU); Millerton, *House 22402;* Washburn Mountain, Copake, *4219;* Austerlitz, *4114*; 2 miles west of Red Rock, *4160.* Represented in our area only by var. **saltuensis** (Fern.) Fern.

L. multiflora (Ehrh.) Lejeune. Wood rush. Dry woods and open places; common throughout.

LILIACEAE (Lily Family)

1. Plants scapose; leaves all basal or nearly so, *2*
   2. Perianth funnel-form, large, orange, 8 to 11 cm. long 3. **Hemerocallis**
   2. Perianth of separate parts, smaller, not orange, *3*
      3. Flowers solitary, yellow, 2 to 3 cm. long; leaves mottled with purple 6. **Erythronium**
      3. Flowers several, smaller; leaves green, *4*
         4. Flowers greenish yellow; fruit blue; leaves oval or elliptic 9. **Clintonia**

4. Flowers white, pink, purplish or greenish white; fruit not blue; leaves at flowering time linear or wanting, *5*
5. Flowers umbellate, often replaced by bulblets; plants with strong onion odor 4. **Allium**
5. Flowers subcorymbose; odor of plants not onionlike 7. **Ornithogalum**
1. Plants not scapose; leaves cauline, *6*
6. Flowers large, 4 to 10 cm. in diameter, yellow or orange, usually spotted; perianth segments all alike 5. **Lilium**
6. Flowers smaller (if over 4 cm. in diameter, the leaves perfoliate or the calyx green), *7*
7. Leaves whorled, *8*
8. Blades parallel-veined; perianth segments all alike, greenish yellow 15. **Medeola**
8. Blades net-veined; calyx green; corolla white or colored 16. **Trillium**
7. Leaves alternate, *9*
9. Blades net-veined, cordate; plants tall, arching or climbing 17. **Smilax**
9. Blades minute and scale-like or, if larger parallel-veined; plants not climbing, *10*
10. Flowers in the axils of the ordinary stem leaves, *11*
11. Perianth tubular, greenish 14. **Polygonatum**
11. Perianth of separate parts, *12*
12. Leaves broad; flowers greenish white or purplish 13. **Streptopus**
12. Leaves minute and scale-like; branches threadlike, appearing feathery 8. **Asparagus**
10. Flowers terminal and solitary, or in terminal spikes, racemes or panicles, *13*
13. Flowers terminal, solitary, 15 to 43 mm. long, yellow 12. **Uvularia**
13. Flowers in terminal spikes, racemes or panicles, *14*
14. Flowers paniculate, green; leaves strongly plaited; plants tall, often 1 to 2 m. high 2. **Veratrum**
14. Flowers racemose or paniculate, white; leaves flat or essentially so; plants smaller, *15*
15. Flowers in a long slender spikelike raceme, dioecious; leaves linear or nearly so 1. **Chamaelirium**
15. Flowers in panicles or short racemes, perfect, *16*
16. Perianth parts and stamens 4 11. **Maianthemum**
16. Perianth parts and stamens 6 10. **Smilacina**

1. **Chamaelirium** Willd.

C. luteum (L.) Gray. Blazing-star. Not seen in recent years. [Claverack, *Rev. A. P. Van Gieson,* June 1869 (V); Pine Plains, *Mabel Hunter,* June 1914 (Syracuse University)]. Reported from Litchfield by Brace (1822), from Hudson by Stebbins (1830), from Pine Plains by Hoysradt (1875-79), and from Nassau by Wibbe (31st Report N. Y. State Mus. 53. 1879).

2. **Veratrum** L.

V. viride Ait. American white hellebore. Wet woods, along streams, or in pastures; frequent. Very abundant eastward, but less so in the Hudson Valley, where local.

3. Hemerocallis L.

H. fulva (L.) L. "Day lily." Along streams, in meadows, and by roadsides; rather commonly established as an escape and growing in large clumps.

4. Allium L. Onion

1. Leaves elliptical, 10 to 23 cm. long, 3 to 6 cm. wide, present in spring and disappearing before flowering time; perianth white; bulblets of umbel none *A. tricoccum*

1. Leaves linear, present at flowering time; perianth pale pink or purple; flowers often replaced by bulblets, *2*

2. Stem leafy near the base only; leaves flat or planoconvex; bulb coats in age strongly netted *A. canadense*

2. Stem leafy to or above the middle; leaves terete; bulb-coats fibromembranous, not strongly netted *A. vineale*

A. tricoccum Ait. Wild leek. Moist rich woods; frequent, especially in calcareous regions and in alluvial soil.

A. canadense L. Wild onion. Alluvial soil along large streams and in wet woods; frequent, especially in the Hudson Valley. Waldorf Pond, *House 21151;* 1 mile north of Riders Mills, *4068;* Arnolds' Mill, Ghent, *4111* (GA); New Forge, *4400* (GH).

A. vineale L. Garlic. Fields, pastures and woodlands; widespread and locally very abundant and weedy.

5. Lilium L. Lily

1. Flowers 1 to 3, erect, the sepals narrowed into claws *L. philadelphicum*

1. Flowers 1 to 16, nodding, the sepals sessile *L. canadense*

L. philadelphicum L. Wood lily. Dry woods and fields and rocky summits; common in the high hills eastward, and locally found in the rocky soils of the central part of the county; unknown in the Hudson Valley. Stephentown Center; No Bottom Pond; Washburn Mountain; Mount Alander; 1 mile south of Taghkanic Lake; 2 miles east of Elizaville; 1 mile east of Pulvers Station, Ghent (PENN).

L. canadense L. Meadow lily, Canada lily. Meadows and wet woods; common, especially in the Hudson Valley.

6. Erythronium L.

E. americanum Ker. Trout lily, Yellow adders-tongue. Meadows, floodplains and moist woods; common.

7. Ornithogalum L.

O. umbellatum L. Star of Bethlehem. Lawns, meadows and waste places; locally established.

8. Asparagus L.

A. officinalis L. Garden asparagus. Often escaped; single plants are commonly seen in fence rows, orchards etc.

9. **Clintonia** Raf.

C. borealis (Ait.) Raf. Dogberry. Cold moist woods; common northeastward and in Bashbish Gorge; unknown below 300 m. elevation. Canticoke Swamp, *1702;* New Britain, *3640;* Douglas Knob, New Lebanon, *4282* (GA); No Bottom Pond, *468;* Canaan Center, *1053;* 2 miles east of Spencertown, *4195* (GH); Brace Mountain, *House* 24798; rare on Stissing Mountain, according to Hoysradt (1875-79).

10. **Smilacina** Desf.

1. Flowers in panicles, minute (1 to 2 mm. long) *S. racemosa*
1. Flowers 3 to 5 mm. long, in simple, few-flowered racemes, *2*
  2. Leaves 7 to 12, with broad and subclasping bases *S. stellata*
  2. Leaves 2 to 4, narrowed at base, not clasping *S. trifolia*

S. racemosa (L.) Desf. False Solomon's seal. Woods and shaded banks; common.

S. stellata (L.) Desf. Known from four localities, all in the Hudson Valley. 4 miles north of Kinderhook, *162* (PENN); 1.5 miles north of Kinderhook, in a springy meadow, *979;* 3 miles north of Claverack, on dry limestone rocks, *540;* 2 miles north of Mellenville, in swampy woods, *4369.* Reported from Pine Plains (Hoysradt) and from Hudson (Stebbins).

S. trifolia (L.) Desf. In our area known only from a sphagnum bog 1 mile west of East Nassau, where it is abundant (*House 23978, House 24646*).

11. **Maianthemum** Wiggers

M. canadense Desf. False lily of the valley. Woods; common. Abundant, especially at the higher elevations.

12. **Uvularia** L.

1. Leaves sessile, not perfoliate; capsule with three winged angles *U. sessilifolia*
1. Leaves perfoliate; capsule 3-lobed, angled, not winged, *2*
  2. Perianth segments granular-pubescent within (2 to 3.5 cm. long); leaves glabrous, glaucous, usually 1 to 3 below the fork *U. perfoliata*
  2. Perianth segments smooth within (2.5 to 4.5 cm. long); leaves whitish pubescent beneath, not glaucous; stem naked or with a single leaf below the fork *U. grandiflora*

U. sessilifolia L. Bellwort. Woods and thickets; common.

U. perfoliata L. Bellwort. Woods and thickets; common.

U. grandiflora Sm. Large-flowered bellwort. Frequent in moist woods in the clay soils of the ravines near the Hudson River; there very abundant locally. Columbiaville, *526;* Becraft Mountain, *2244.* Known from ravines just north of Hudson and from a ravine 2 miles west of Stuyvesant Falls. Elsewhere in our region rare; occurs on limestone talus at Old Chatham, and is reported by Hoysradt from the town of Ancram ("Woods 1.5 miles southwest of Hot Ground").

13. **Streptopus** Michx.

1. Leaves glaucous beneath, strongly clasping; flowers greenish white; fruit scarlet *S. amplexifolius*
1. Leaves green both sides, rounded at base but scarcely clasping; flowers rose-purple; fruit cherry red *S. roseus*

S. amplexifolius (L.) DC. Cool moist woods; known only from the gorge of Bashbish Brook, Copake, at an elevation of about 250 m., *3562*. Represented in our area only by var. **americanus** Schultes.

S. roseus Michx. Twisted stalk. Rocky woods; frequent eastward, at the higher elevations, but unknown below 300 m. elevation. Perry Peak, Canaan, *House 21199;* Washburn Mountain, *3332;* Hillsdale, *592*. Seen also at Stephentown and Mount Lebanon (House); 2 miles east of Austerlitz; Bashbish Mountain. Represented in our area only by var. **perspectus** Fassett.

14. Polygonatum Mill. Solomon's seal

1. Cauline bract papery, soon withering; leaves essentially sessile, puberulent beneath; flowers mostly 10 to 12 mm. long *P. pubescens*

1. Cauline bract green, leaflike, persistent; leaves somewhat clasping, glabrous; flowers mostly 14 to 20 mm. long *P. canaliculatum*

P. pubescens (Willd.) Pursh. Woods and thickets, common.

P. canaliculatum (Muhl.) Pursh. Moist thickets, often in alluvial soil; frequent in the Hudson Valley. Unknown elsewhere. Hotaling Island, *Taylor 1395* (NY); Poelsburg, *898;* Kinderhook, *1068;* along creek 2 miles north of Stuyvesant, *2526;* east of Blue Hill, *House 22683*.

15. Medeola L.

M. virginiana L. Indian cucumber root. Moist woods; common.

16. Trillium L. Wake-robin

1. Ovary sharply 6-angled or winged, *2*

2. Fruit white or nearly so sometimes tardily red; flower recurved or reflexed under the leaves; petals white or very pale pink *T. cernuum*

2. Fruit dark purple; flower erect or somewhat declined; petals brownish purple or rarely green *T. erectum*

1. Ovary obscurely 3-lobed; mature fruit scarlet; petals white with a red-purple spot at base of each *T. undulatum*

T. cernuum L. White trillium. Moist woods; locally abundant in the Hudson Valley; otherwise unknown. 1 mile north of Kinderhook, *673;* Waldorf Pond, *House 21138;* 2 miles east of Greendale, *4326*.

T. erectum L. Red trillium, carrion flower. Moist woods; common.

T. undulatum Willd. Painted trillium. Moist or sandy woods; frequent at the higher elevations northeastward; unknown below about 300 m. elevation. Canticoke Swamp, *1706;* Lebanon Springs, *4291* (GH, GA); No Bottom Pond, *457*.

17. Smilax L.

1. Stems herbaceous, not prickly *S. herbacea*

1. Stems woody, beset with prickles, *2*

2. Small branchlets more or less quadrangular; prickles scattered, stout; peduncles about as long as the petioles *S. rotundifolia*

2. Small branchlets nearly terete; lower part of stem densely beset with long weak blackish bristle-like prickles; peduncles 2 to 4 times as long as the petioles *S. tamnoides*

S. herbacea L. Carrion flower. Woods and thickets; common. Apparently most abundant in the Hudson Valley. Waldorf Pond, *218* (PENN); Bachus Pond, *925;* Hotaling Island, *Taylor 1375* (NY); Kinderhook, *1066;* Rogers Island, *2564;* Stissing Mountain, summit, *2832*.

S. rotundifolia L. Catbrier, greenbrier. Reported from both Dutchess and Rensselaer Counties, but the only known station in our area is on the shore of Upper Twin Lake, Elizaville, where the plant is abundant, *3273*

S. tamnoides L. In swamps near the Hudson River; locally abundant. Tidal marshes east of Crugers' Island, *2905*; thickets near mouth of Roeliff Jansen Kill; tidal marshes on Rogers Island, *2591;* Catskill, Greene County, *Peck.* Our plants belong to var. **hispida** (Muhl.) Fern.

AMARYLLIDACEAE (Amaryllis Family)

Hypoxis L.

H. hirsuta (L.) Coville. "Yellow-eyed grass." Sandy or rocky woods, usually in dry, partially shaded places; frequent. Apparently more abundant at lower elevations. About ½ mile west of Brainard, *House 21366;* Malden Bridge, near Bachus Pond, *913;* 4 miles north of Kinderhook, *167* (PENN); Columbiaville, *775;* Copake Falls, according to Stetson (1913).

DIOSCOREACEAE (Yam Family)

Dioscorea L.

D. villosa L. Wild yam root. Known only from the moist woods and tidal marshes east of Crugers' Island, *2666, 3248.*

IRIDACEAE (Iris Family)

1. Flowers 5 to 8 cm. long; style branches broad and petaloid, opposite the anthers **1. Iris**
1. Flowers 1 to 2 cm. long; style branches filiform, alternate with the anthers; plant grasslike **2. Sisyrinchium**

1. Iris L.

I. versicolor L. Blue flag, wild iris. Wet places and marshes; common.

2. Sisyrinchium L. "Blue-eyed grass"

1. Bracts of the spathe subequal, 1.5 to 2 cm. long; stem coarse, conspicuously winged, mostly 3 to 6 mm. wide; umbels of flowers rarely fewer than two in number *S. angustifolium*
1. Outer bract much exceeding the inner, 2 to 6.5 cm. long; stem simple, 1.5 to 3 mm. wide; umbel solitary or rarely 2 *S. montanum*

S. angustifolium Mill. Meadows and open fields, or in partial shade, in moist or dry soil; frequent. 2 miles east of Austerlitz, *2286;* 2 miles south-southwest of Green River, *3531;* east of Poelsburg, *1685;* Rhinecliff, Dutchess County, *House 19267.*

S. montanum Greene. Meadows and open fields, in moist or dry soil; frequent. New Lebanon, *House 21299;* 1 mile northwest of Brainard, *House 21386;* wet meadow south of Canaan, *741;* 2 miles east of Austerlitz, *694;* Miller Pond, Ancram, *House 20542;* south of Fowlers' Lake, *709.* Represented in our area by var. **crebrum** Fern.

ORCHIDACEAE (Orchid Family)

1. Lip of corolla an inflated pouch, anthers 2 1. **Cypripedium**
1. Lip flat or concave, but not an inflated pouch; anther 1, *2*
2. Flowers with a distinct slender spur, this at least 2 mm. long, *3*

3. Lip white; petals and sepals purple; leaves 2, basal **2. Orchis**
3. Divisions of the perianth concolorous, variously colored; leaves various **3. Habenaria**
2. Flowers not spurred, but sometimes saccate at base, *4*
4. Plant with green stems and foliage (leaves sometimes absent at flowering time), *5*
5. Flowers large, the perianth 1.5 to 4.5 cm. long, *6*
6. Leaves linear, more or less grasslike, or reduced to sheaths only, *7*
7. Flowers several, in a raceme, inverted (with the lip uppermost) **7. Calopogon**
7. Flowers solitary, terminal, not inverted **6. Arethusa**
6. Leaves elliptic to ovate, *8*
8. Leaf solitary; sepals equaling the lip **4. Pogonia**
8. Leaves whorled; sepals narrow, much exceeding the lip **5. Isotria**
5. Flowers smaller, the perianth segments 1 cm. long or less, *9*
9. Sepals and petals, except the lip, erect and connivent; flowers essentially sessile, in a compact spiral or cylindrical spike, *10*
10. Leaves variegated with a network of white veins; raceme 1-sided or densely flowered **10. Goodyera**
10. Leaves green, never variegated; flowers in 1 to 4 ranks in a spirally twisted raceme **9. Spiranthes**
9. Sepals and petals free; flowers in a loose raceme, on pedicels at least 2 mm. long, *11*
11. Petals filiform or linear, less than 2 mm. broad, *12*
12. Leaf solitary **11. Malaxis**
12. Leaves 2, basal **12. Liparis**
11. Petals ovate, broader; sepals 8 to 10 mm. long; plants coarse, 25 to 60 cm. high **8. Epipactis**
4. Plants lacking green coloration, the stems leafless, scaly, yellowish or brownish **13. Corallorhiza**

1. Cypripedium L.

1. Plant acaulescent, 2-leaved at base; flower solitary, the lip pink; sepals and petals greenish brown *C. acaule*
1. Plant leafy stemmed; flowers 1 to 3, *2*
2. Lip golden yellow *C. Calceolus*
2. Lip white, suffused with pink in front *C. reginae*

C. acaule Ait. Pink lady's-slipper. Dry woods, in more or less acid soil, or in sphagnum bogs; common eastward, except in calcareous regions; rare in the Hudson Valley.

C. Calceolus L. Yellow lady's-slipper. In rich, often calcareous woods; frequent, except in regions of prevailingly acid soil. West of North Chatham, *House 21163;* Stuyvesant, *Iva Allen,* June 30, 1895; Rogers Island, *2560;* 2 miles east of Greendale, *4328* (GA); well known near Kinderhook, and in the calcareous soils of the Harlem Valley. Represented in our area only by var. **pubescens** (Willd.) Correll.

C. reginae Walt. Showy lady's-slipper. Known from but 2 localities, these about 1 km. apart; both in swampy woods in calcareous regions in the town of Ancram, *1082, 3903.* Reported also by Hoysradt from the "Fingar Marsh," town of Gallatin, but has not been rediscovered at this locality.

2. Orchis L.

O. spectabilis L. Showy orchis. Rich, often calcareous soil in woods; frequent, except under conditions of prevailingly acid soil.

3. Habenaria Willd.

1. Lip of corolla deeply fringed, *2*
  2. Lip deeply 3-parted, the divisions fringed, *3*
    3. Flowers greenish — *H. lacera*
    3. Flowers purplish pink; divisions fringed about ⅓ their depth; lip about 1 to 1.2 cm. wide — *H. psycodes*
  2. Lip not deeply 3-parted; flowers bright white — *H. Blephariglottis*
1. Lip of corolla not fringed, *4*
  4. Leaves usually 2, basal, orbicular or elliptic, 3.5 to 10 cm. broad; scape usually without bracts, with 8 to 20 yellowish green flowers; lip about 1 cm. long — *H. Hookeri*
  4. Leaves 2 or more, cauline, narrow, *5*
    5. Lip lanceolate, entire; leaves more than 2 — *H. hyperborea*
    5. Lip oblong, truncate, 3-toothed at apex; leaves 1 or 2, oblong or often oblanceolate, obtuse — *H. clavellata*

H. lacera (Michx.) Lodd. Ragged orchis. Meadows, open fields and woods; frequent. 2 miles south-southwest of Green River, *3541;* 1 mile south of Germantown, *3316;* near pond, 1.5 miles south of Ancramdale, *3379.* Seen also at Lebanon Springs; about 2 miles north-northwest of Copake Falls; near "Fingar Marsh," Gallatin; meadow north of Kinderhook; pasture at Tivoli.

H. psycodes (L.) Spreng. Purple fringed orchis. Swampy woods, or occasionally in meadows; common. One of our three commonest orchids, the others being *Spiranthes gracilis* and *Corallorrhiza maculata.* Reports of *Habenaria fimbriata* from our area doubtless refer to *H. psycodes* (figure 11).

H. blephariglottis (Willd.) Hook. White fringed orchis. Sphagnum bogs; rare. Bog southeast of Knickerbocker Lake, *1438;* reported from Copake Falls (Stetson, 1913) and from Hoags' Corners by Wibbe (Gordinier & Howe, 1894).

H. Hookeri Torr. Reported from the west side of Stissing Mountain by Hoysradt; occurs on a steep rocky (acid) slope about 1 mile northeast of Riders Mills, *734.* At the Riders Mills station it is associated with *Luzula carolinae* var. *saltuensis, Epigaea repens, Polygala paucifolia* and *Viola rostrata.*

H. hyperborea (L.) R. Br. Rocky woods, in both acid and calcareous soils; infrequent. Rare in the Hudson Valley. Old Chatham, on limestone talus, *1403;* 2.5 miles east of Chatham Center, *3675;* north of Robinson Pond, *3942;* Washburn Mountain, *3327;* Copake, *H. M. Denslow.*

H. clavellata (Michx.) Spreng. Sphagnous woods, where frequent. Canticoke Swamp, *1728* (PENN); New Britain, *3642;* 4 miles north of Kinderhook, *2993;* 2 miles southeast of Churchtown, *3505;* known also from the "Fingar Marsh," town of Gallatin.

4. Pogonia Juss.

P. ophioglossoides (L.) Ker. Open bogs, usually in sphagnum, but sometimes in calcareous situations; abundant in suitable habitats. Bog southeast of Knickerbocker Lake, *1021;* bog 3 miles southeast of Harlemville, *1129;* south of Pulvers Corners, *3861.*

5. Isotria Raf.

I. verticillata (Willd.) Raf. [Claverack, *Rev. A. P. Van Gieson,* June, 1869

(V)]; reported from Pine Plains as "rather scarce" by Hoysradt. An immature plant collected by N. L. Britton at Copake Falls, now at the New York Botanical Garden, is apparently this species. Otherwise unknown.

6. **Arethusa** L.

A. **bulbosa** L. Sphagnum bogs; rare. Reported as "very rare" at Pine Plains, by Hoysradt. Occurs in a bog about 3 miles southeast of Harlemville, where rather abundant, *1128*.

7. **Calopogon** R. Br.

C. **pulchellus** (Salisb.) R. Br. Open bogs; usually in sphagnum, where locally abundant, but occasionally in calcareous situations. Bog southeast of Knickerbocker Lake, *1156;* bog south of Niverville, *1143;* bog 2 miles south of Copake Lake, *1071;* Miller Pond, Ancram, *3115,* "Fingar Marsh," Gallatin, *3577*.

8. **Epipactis** Sw.

E. **Helleborine** (L.) Crantz. Known only from the following localities; limestone talus slope 3 miles north of Claverack, *1301;* a similar habitat southwest of West Ghent, *3300;* 3 miles east of Stuyvesant, in moist clay soil in woods, *1547*. A European species not previously reported from our area, and apparently spreading from western New York, where it is extensively naturalized.

9. **Spiranthes** Richard

1. Flowering stem leafless; leaves ovate, basal, disappearing before the flowering season; lip less than 5 mm. long; flowers opening June to September *S. gracilis*

1. Flowering stem leafy, at least toward the base; lip 5 to 10 mm. long, *2*

2. Lip quadrate, yellowish; flowering period late May to July *S. lucida*

2. Lip ovate-oblong, creamy white; flowering period September to October *S. cernua*

S. **gracilis** (Bigel.) Beck. (incl. *S. lacera* of *Gray's Manual*). Dry grassy fields; common.

S. **lucida** (H. H. Eat.) Ames. Silvernails, *1090;* Stuyvesant Falls, *935, 3127*. In both known localities the plant occurs on shale rocks in the beds of large streams.

S. **cernua** (L.) Richard. In wet meadows and open bogs, or in dry sandy and gravelly fields; frequent. Bog 4 miles north of Kinderhook, *159* (PENN); boggy meadow south of Canaan, *2327* (PENN); boggy meadow east of Austerlitz, *2288;* sandy hillside about 4 miles north of Kinderhook, *2365;* [Claverack, *Rev. A. P. Van Gieson* (V)]; ¾ mile south of Pulvers Corners, *3857*. The plant of upland, acid soils has been designated as var. **ochroleuca** (Rydb.) Ames (figure 12).

10. **Goodyera** R. Br.

G. **pubescens** (Willd.) R. Br. "Rattlesnake Plantain." Dry woodlands; rare. West of Brainard, *House 21523;* about 3 miles north of Kinderhook, *1472*. Reported by Hoysradt from Pine Plains.

11. **Malaxis** Sw.

M. unifolia Michx. Swampy woods; apparently rare. Canticoke Swamp, *1715;* bog 3 miles southeast of Harlemville, *1901* (PENN). Reported by Hoysradt from "G. Rowe Woods," in Gallatin.

12. **Liparis** Richard

1. Lip of corolla wedge-obovate, purple *L. lilifolia*
1. Lip oblong or obovate, green *L. Loeselii*

L. lilifolia (L.) Richard. [Stissing Mountain, *Egbert Hyatt,* in 1873 (V)]. Otherwise unknown.

L. Loeselii (L.) Richard. Twayblade. Swampy woods and open bogs; frequent. Occasionally in dry soil. Bog west of Douglas Knob, New Lebanon, *2118;* bog 2 miles south of Copake Lake, *2597;* about 3 miles north of Ancramdale, *3901;* Knickerbocker Lake, *1198;* 1.5 miles north of Kinderhook, *1780;* dry acid hillside 1.5 miles southwest of Canaan Center, *3598.*

13. **Corallorhiza** Chatelain

1. Lip of corolla 3-lobed, *2*
  2. Plant yellow, 4 to 20 cm. high; lip white, not spotted; plants flowering in May *C. trifida*
  2. Plant purplish or yellowish brown, mostly 20 to 40 cm. high; lip white, spotted with purple, 6 to 8 mm. long; plants flowering July to September *C. maculata*
1. Lip of corolla unlobed, white, spotted with magenta-crimson, 4 mm. long; plants 20 cm. high or less; flowering August to October *C. odontorhiza*

C. trifida Chatelain. Known only from wet sphagnous woods at New Britain, *4304.* An unverified report of the species from Copake Falls was made by Stetson (1913).

C. maculata Raf. Moist shady woods; common.

C. odontorhiza (Willd.) Nutt. Known only from woods, in calcareous soil, north of Robinson Pond, *3923.*

Subclass II. DICOTYLEDONEAE
JUGLANDACEAE (Walnut Family)

1. Outer husk of fruit splitting into 4 valves at maturity; nut shell smooth, often angled; pith of twigs solid 2. **Carya**
1. Outer husk of fruit not splitting at maturity; nut shell furrowed or corrugated; pith of twigs in transverse plates dividing the twigs into little chambers 1. **Juglans**

1. **Juglans** L.

1. Fruit oblong, the husk sticky; petioles and young twigs sticky; leaf scar with a downy pad at upper edge *J. cinerea*
1. Fruit globose, not sticky; petioles and young twigs minutely downy, not sticky; leaf scar with no downy pad *J. nigra*

J. cinerea L. Butternut. Woods, especially in moist places; common throughout.

J. nigra L. Black walnut. In woods and along streams; rare. Not surely native in our area; long in cultivation. Reported from Kinderhook by Wood-

worth (1840) and as "quite common" at Pine Plains by Hoysradt. Rocky hill south of Spencertown, *House 20576;* alluvial flats east of Bells' Pond, along Taghkanic Creek, *3305*. At the last-mentioned locality there are several large trees and numerous seedlings becoming established from them.

2. **Carya** Nutt.

1. Husk of fruit readily splitting to the base into 4 valves, *2*
  2. Leaf rachis and young branchlets persistently tomentose; bark not peeling off in strips *C. tomentosa*
  2. Leaf rachis and branchlets glabrous or slightly downy; bark often peeling off in long shaggy strips, *3*
    3. Nut with ridges or angles, somewhat flattened; bark strongly shaggy *C. ovata*
    3. Nut scarcely ridged or angled, nearly globose; bark peeling off, when old, in narrow plates *C. ovalis*
1. Husk of fruit scarcely splitting or tardily so, often at apex only; bark never peeling off in shaggy strips, *4*
  4. Leaflets 7 to 11, coarsely toothed; buds scurfy, bright yellow *C. cordiformis*
  4. Leaflets 5 to 7, finely serrate; buds smoothish, gray-brown or darker *C. glabra*

C. cordiformis (Wang.) K. Koch. Swamp hickory. Along streams and in wet woods; common in the Hudson Valley and occurring in the Harlem Valley, but rare and infrequent northeastward. Mill Creek, Stuyvesant, *1555;* Becraft Mountain, *336* (PENN); 1.5 miles southeast of Clermont, *3230;* Tivoli, *2732*; 2 miles southwest of Hillsdale, *3557*. Reported by Harrison (1887, as *C. amara*) from Lebanon Springs.

C. ovata (Mill.) K. Koch. Shagbark Hickory. Woods; frequent. Throughout, but never very abundant.

C. tomentosa Nutt. Mockernut. Rich or moist woods; frequent in the Hudson Valley. Unknown elsewhere. 3 miles north of Castleton, *3981;* Hudson River at Columbiaville, *3726;* woods east of Clermont, *3255;* Tivoli.

C. glabra (Mill.) Sweet. Pignut. Woods and fence rows; common.

C. ovalis (Wang.) Sarg. Apparently infrequent, but distribution unknown. Kinderhook Lake, *Brown*. If, as suggested by Wiegand and Eames (1926), this species turns out to be a hybrid between *C. glabra* and *C. ovata,* we should not expect very much of it in our region, where *C. ovata* is never represented by large numbers of individuals.

MYRICACEAE (Sweet-gale Family)

1. Leaves pinnatifid, with many fernlike rounded lobes **1. Comptonia**
1. Leaves serrate or subentire **2. Myrica**

1. **Comptonia** L'Hér.

C. peregrina (L.) Coult. Sweet Fern. Dry sandy or stony soil; very common eastward, but uncommon or rare in the Hudson Valley. Poelsburg, on bluffs above the Hudson River, *1686*.

2. **Myrica** L.

1. Leaves oblanceolate, mostly 7 to 15 mm. broad; twigs blackish; pistillate catkins becoming conelike in fruit *M. Gale*

1. Leaves oblong to obovate, 15 to 40 mm. broad; twigs brown; fruits separate, hard, drupelike, wax-coated *M. pensylvanica*

M. Gale L. Bogs, and borders of lakes and streams; infrequent, but locally abundant. Kinderhook Lake, *1227;* Waldorf Pond, *House 20951;* Taplins' Pond, *2415;* Shaver Pond, Copake, *842;* south of Mount Riga Station, *3372.*

M. pensylvanica Loisel. Bayberry. Known only from a sandy field south of Knickerbocker Lake, *House 23705,* and from a calcareous marsh at the south end of Miller Pond, Ancram, 1073. At Miller Pond the species is associated with *Larix laricina, Betula pumila, Valeriana sitchensis, Eriophorum viridi-carinatum, Iris versicolor* and *Rhus Vernix.*

SALICACEAE (Willow Family)

1. Leaves (in our species) broad and more or less heart-shaped or ovate; winter buds covered by several overlapping scales; stamens 8 to 30 or more; flower bracts fringed **1. Populus**

1. Leaves (in our species) mostly narrow, long and pointed; winter bud scale 1 only; stamens few (3 to 10); flower-bracts entire or merely toothed **2. Salix**

1. **Populus** L. Poplar

1. Buds, 1-year-old branchlets and lower surface of mature leaves densely white-tomentose *P. alba*

1. Plants not white-tomentose, or the young leaves somewhat so, *2*

- *2.* Petioles terete or grooved; buds strongly resinous-sticky; leaves broadly ovate, rounded or cordate at base, smooth on both sides, finely crenate *P. balsamifera*
- *2.* Petioles strongly flattened laterally, *3*
  - *3.* Styles with narrow or filiform lobes; winter buds scarcely resinous, mostly 3 to 7 mm. long; flowering scales silky, *4*
    - *4.* Leaves finely crenate-serrulate, glabrous even when young *P. tremuloides*
    - *4.* Leaves coarsely undulate-dentate, tomentose when young *P. grandidentata*
  - *3.* Styles with dilated lobes; winter buds strongly resinous, often 1 cm. or more long; flowering scales glabrous or few-haired, *5*
    - *5.* Leaf blades mostly deltoid, truncate or subcordate at base; petiole with two glands at upper end *P. deltoides*
    - *5.* Leaf blades rhombic, truncate to rounded at base; petiole without glands *P. nigra*

P. alba L. White poplar. Sometimes established in lawns and fields as an escape from cultivation.

P. balsamifera L. Balsam poplar. Mount Lebanon, *House 16127*; [Stephentown Center, *D. B. Cook*]. Otherwise unknown, and perhaps never native.

P. grandidentata Michx. Large-toothed aspen. Woods and thickets and along streams; frequent.

P. tremuloides Michx. Quaking aspen. With the preceding; common throughout.

P. nigra L. Black poplar. Reported by House (1924) as "especially common in the valley of the Hudson River and along tributary streams . . . ." This report has not been verified, and may be based on the next species, which is abundant and weedy along the Hudson.

P. deltoides Marsh. Cottonwood; Carolina poplar. In moist soil, near water; frequent.

2. **Salix** L. Willow

A. Key based on fruiting characters[1]

1. Flower scales (bracts) yellow (see also *S. Bebbiana*), deciduous; mature capsules glabrous (except sometimes in *S. interior*); aments leafy-peduncled, appearing with the leaves, *2*
- *2.* Aments stout, dense; blades serrulate, *3*
  - *3.* Blades ovate; introduced ornamental tree — *S. pentandra*
  - *3.* Blades lanceolate; native shrubs, *4*
    - *4.* Blades green beneath; fruit mature in early summer (June-July) — *S. lucida*
    - *4.* Blades glaucous beneath; fruit mature in late summer (August-October) — *S. serissima*
- *2.* Aments slender, lax; leaves various, *5*
  - *5.* Blades linear, remotely denticulate, green beneath; native shrub; stamens 2 — *S. interior*
  - *5.* Blades lanceolate, serrulate, *6*
    - *6.* Blades green beneath, linear-lanceolate; native tree; stamens 3 to 5 or more — *S. nigra*
    - *6.* Blades glaucous beneath, lanceolate; introduced trees; stamens 2, *7*
      - *7.* Capsule sessile, ovoid; blades silky on both sides — *S. alba* var. *argentea*
      - *7.* Capsule short-pedicelled, conic; blades glabrous — *S. fragilis*

1. Flower scales brown to black (yellow in *S. Bebbiana*), persistent; capsules and aments various, *8*
- *8.* Capsules glabrous, pedicellate; aments leafy-peduncled, appearing with the leaves; blades glabrous when mature, *9*
  - *9.* Blades serrate, lanceolate, 6 to 10 cm. long, glaucescent beneath — *S. rigida*
  - *9.* Blades entire, elliptic-oblanceolate, 3 to 5 cm. long, glaucous beneath — *S. pedicellaris*
- *8.* Capsules permanently hairy; aments various, *10*
  - *10.* Capsules silvery pubescent, *11*
    - *11.* Capsules 2 to 5 mm. long, subsessile; aments small, narrow, sessile, *12*
      - *12.* Capsules 2 to 4 mm. long, ovate; blades subopposite, glabrous, subentire — *S. purpurea*
      - *12.* Capsules 3 to 5 mm. long, short-conic, blunt; blades silvery pubescent beneath, serrate — *S. sericea*
    - *11.* Capsules 5 to 8 mm. long, on pedicels 2 to 4 mm. long; aments broad, leafy-pedunculate, *13*
      - *13.* Blades glabrous when fully expanded — *S. petiolaris*
      - *13.* Blades more or less silvery silky on both sides when fully grown — *S. subsericea*
  - *10.* Capsules white or gray-woolly; aments subsessile, appearing in early spring before the leaves, *14*
    - *14.* Styles 1 to 1.5 mm. long; capsules 6 to 8 mm. long, white-woolly — *S. candida*
    - *14.* Styles 0.3 to 0.5 mm. long; capsules 7 to 10 (12) mm. long, gray-woolly, beaked, *15*
      - *15.* Pedicels 1 to 3 mm. long; aments stout, dense, sessile, *16*
        - *16.* Blades and branchlets glabrous — *S. discolor*

[1] The keys to *Salix* have been contributed by Dr. Carleton R. Ball. Specimens of *Salix*, cited in the text below and designated by an asterisk (*), have been identified by Dr. Ball.

16. Blades (beneath) and branchlets pubescent-tomentose *S. humilis*

15. Pedicels 3 to 6 mm. long; aments lax, short-pedunculate; scales linear, yellowish; leaves rugose, pubescent *S. Bebbiana*

B. Key based on mature foliage

1. Leaves green on both sides, *2*

2. Margins closely serrate or serrulate, *3*

3. Blades lanceolate to ovate; petioles glandular, *4*

4. Blades lanceolate or broader, long-acuminate *S. lucida*

4. Blades ovate or oval, acute to short-acuminate *S. pentandra*

3. Blades linear-lanceolate; petioles not glandular *S. nigra*

2. Margins remotely spinulose-denticulate or subentire, *5*

5. Blades linear, remotely denticulate *S. interior*

5. Blades oblanceolate, subopposite, entire or serrulate on distal margin *S. purpurea*

1. Leaves glaucous or glaucescent beneath, *6*

6. Blades lanceolate, closely serrate or serrulate on margins, *7*

7. Petioles (usually) glandular apically, *8*

8. Blades glabrous at maturity; petioles always glandular, *9*

9. Blades finely serrulate, acute *S. serissima*

9. Blades coarsely serrulate, long-acuminate *S. fragilis*

8. Blades sericeous at maturity; petioles not always glandular *S. alba* var. *argentea*

7. Petioles never glandular, *10*

10. Mature blades glabrous (except midribs), *11*

11. Blades lanceolate or broader, the base rounded or cordate *S. rigida*

11. Blades narrowly lanceolate or elliptic-oblong, the base acute *S. petiolaris*

10. Mature blades silvery silky beneath, *12*

12. Blades 5 to 10 cm. long, glabrous above *S. sericea*

12. Blades 3.75 to 7.5 cm. long, somewhat silky on both sides *S. subsericea*

6. Blades linear-elliptical to broadly elliptical or oblanceolate, entire to undulate-crenate on margins, *13*

13. Blades glabrous at maturity, *14*

14. Low bog plant; blades linear-oblanceolate, entire *S. pedicellaris*

14. Tall plants of alluvial soil; blades elliptic-oblanceolate, undulate-crenate *S. discolor*

13. Blades more or less hairy at maturity, at least beneath, *15*

15. Bog plants; branchlets and leaves densely white-tomentose; blades linear-oblong to linear-oblanceolate, rugose, entire *S. candida*

15. Plants of uplands; branchlets and leaves more or less gray-pubescent, *16*

16. Plants of dry ground; blades narrowly to broadly oblanceolate, reticulate beneath *S. humilis*

16. Plants of stream banks; blades broadly elliptical to obovate, rugose beneath *S. Bebbiana*

S. nigra Marsh. Black willow. Alluvial banks and margins of streams and ponds; frequent. Our only arborescent native willow. Bachus Pond, *3166*;* Kinderhook Lake, *House 15544**, *16788**.

S. pentandra L. Bay-leaved willow. Mount Lebanon, near State line, House *15589**. Otherwise unknown, and probably not established at this locality.

S. lucida Muhl. Shining willow. Swamps and wet places; throughout, but rather infrequent. Bachus Pond, *3167*;* New Britain, *4297**; Rogers Island, *2584**; south of Pulvers Corners, *3859**.

S. serissima (Bailey) Fern. Wet places and bogs; frequent. Especially abundant in the calcareous marshes of the Harlem Valley. Kinderhook Lake, *House 15545*;* bog south of Hemlock School, Ghent, *566*;* Miller Pond, Ancram *3117**; south of Boston Corners, *1662**; south of Pulvers Corners, *3864**. Reported by Knowlton (1919) from a "calcareous swamp north of Copake."

S. interior Rowlee. River-bank willow. Sand flats at Nutten Hook, where abundant and forming large patches, *4748** (USNA). Otherwise unknown.

S. alba L., var. **argentea** Wimm. Sand flats at Nutten Hook, *4751** (USNA). Otherwise unknown.

S. fragilis L. Crack willow. Often cultivated, and frequently established along streams and in wet places near dwellings. A large tree. 1 mile north of Kinderhook, *4246**; 2 miles northeast of Chatham, *4167**.

S. rigida Muhl. Swamps and alluvial grounds, common. Especially abundant along the Hudson River and the larger streams. Mount Lebanon, *House 16148**; Perry Peak, Canaan, *House 21175*, 21187*;* Hotaling Island, *3153*;* Kinderhook *4406**; tidal marsh south of Tivoli *2660** (PENN).

S. purpurea L. Purple willow. Wet ground; infrequent or rare. Hotaling Island, *3144**; 1 mile north of Kinderhook, *4241**.

S. candida Flügge. Hoary willow. Calcareous marshes, or rarely in acid situations; locally abundant in the limestone regions of the Harlem Valley. About 1 mile east of Fowlers' Lake, Ghent, *565*; bog 2 miles south of Copake Lake, *2616*;* Copake Falls, *Britton et al.* (NY); Miller Pond, Ancram, *House 20547**; marsh south of Pulvers Corners, *3862*.

S. sericea Marsh. Silky willow. Wet grounds; common. Hotaling Island, *3150*;* 1 mile north of Kinderhook, *4249*;* 1 mile southeast of Churchtown, *4173*;* swamp south of Mount Riga Station, *3368*. A plant from Pulvers Corners is either this species or *S. sericea* × *S. humilis,* according to Dr. Ball.

S. subsericea (Anderss.) Schneid. Known from a single collection, *3856**, from the calcareous region south of Pulvers Corners.

S. petiolaris Sm. (*S. gracilis* of *Gray's Manual*). ½ mile west of Canaan, *4147*;* ½ mile west of Spencertown, *4120**. Both collections are from springy places on rocky hillsides. Otherwise unknown.

S. Bebbiana Sarg. In moist soil, or less often in upland situations. Perry Peak, Canaan, *House 21186**; 2 miles north of Chatham, *4102**; Millerton, *House 22400**. Not reported from the Hudson Valley.

S. discolor Muhl. Pussy willow. Springy places and in swamps; common Mount Lebanon, *House 16149*;* Perry Peak, Canaan, *House 21183*;* swamp south of Mount Riga Station, *3371**; 1 mile north of Kinderhook, *2500**, *2503** (PENN); 1 mile southeast of Churchtown, *4174**.

S. humilis Marsh. Prairie willow. Dry sandy or rocky places, usually in partial shade; rather frequent. Southeast of Brainard, *House 21524*;* Canaan Center, in calcareous soil in woods, *2320*;* sandy soil north of Kinderhook, *2501*, 2502** (PENN); Stissing Mountain, *2850** (PENN); [1.5 miles west of Austerlitz, *4203*].

S. pedicellaris Pursh. Known only from an acid bog 2 miles south of Copake Lake, *3446**. Reported by Hoysradt (1875-79) from a peat bog on Stissing Mountain (as *S. myrtilloides* L.). Represented in our area by var. **hypoglauca** Fern.

BETULACEAE[1] (Birch Family)

1. Staminate flowers 1 to each bract, destitute of calyx; pistillate flowers with a calyx, *2*
2. Staminate flowers with 2 bractlets; pistillate flowers 1 to 4, in a dense capitate cluster; nut large, more than 1 cm. high, inclosed by a conspicuous villous involucre 3. **Corylus**
2. Staminate flowers with no bractlets; pistillate flowers in a raceme; nut small, much less than 1 cm. high, *3*
3. Nut inclosed in a bladderlike bract; bark brownish, furrowed, scaling off 2. **Ostrya**
3. Nut subtended by a large flat leafy 3-cleft bract; bark iron-gray, smooth, not scaly 1. **Carpinus**
1. Staminate flowers 2 to 6 to each bract; calyx present; pistillate flowers without a calyx, *4*
4. Pistillate spikes solitary; fruiting bracts early deciduous, thin, 3-lobed 4. **Betula**
4. Pistillate spikes racemose; fruiting bracts long-persistent, woody, not lobed 5. **Alnus**

1. **Carpinus** L.

C. caroliniana Walt. Hornbeam, ironwood. Moist woods, often along streams; common throughout. Represented in our area only by var. **virginiana** (Marsh.) Fern.

2. **Ostrya** Scop.

O. virginiana (Mill.) K. Koch. Hop hornbeam, ironwood. Dry, especially rocky, woods; common throughout.

3. **Corylus** L. Hazelnut

1. Involucre of the fruit short, spreading and exposing the nut; twigs and petioles often glandular-bristly *C. americana*
1. Involucre of the fruit much prolonged above the nut into a narrow tubular beak; twigs and petioles not glandular-bristly *C. cornuta*

C. americana Walt. Woods and thickets, often in dry sandy places; common in the Hudson and Harlem Valleys, but not recorded from the higher elevations to the northeast. Southeast of Brainard, *House 21536;* 3 miles north of Kinderhook, *1313;* Mill Creek, Stuyvesant, *231;* north of Tivoli, *2964;* [North Chatham, *House 20451;* west base of Brace Mountain, *House 24860*].

C. cornuta Marsh. Rocky woods; the common hazelnut in the eastern part of the county, but decreasing westward and unknown from the Hudson Valley. Southeast of Brainard, *House 21537;* Lebanon Springs, according to Harrison (1887); 1 mile east of Pulvers, Ghent, *882;* Mount Fray, Copake, *2623;* Copake Falls, *Britton et al.* (NY); Long Pond, Ancram, *3433.*

4. **Betula** L. Birch

1. Plants slender, shrubby, sometimes 4 m. high but scarcely treelike, usually much smaller; leaves 2 to 3 cm. long, with 2 to 5 pairs of veins; wings of fruit narrower than the body *B. pumila*
1. Plants arborescent; leaves 5 to 12 cm. long, with 5 to 11 pairs of veins, *2*
2. Fruiting cones short-cylindric, erect, sessile or nearly so; leaves usually with 9 to 11 pairs of veins, *3*

[1] *Corylaceae* of *Gray's Manual.*

Figure 13. Trunk of a mature tree of *Betula lutea* in the gorge of Bashbish Brook, Copake. The scale is indicated by a filmpack which is about 11 cm. in length.

Figure 14. Sand flats just north of Nutten Hook, looking south. The New York Central Railroad is at the left, at the base of the hill. The plant in the foreground is *Cycloloma atriplicifolium*. This picture was taken on October 6, 1935; at the present time much of the sandy area has been occupied by *Populus deltoides* and most of the herbaceous vegetation has been shaded out.

Figure 15. A nearly pure stand of *Nuphar advena* in the South Bay below Tivoli, looking east from the New York Central Railroad. The woods in the background are about 1 km. distant.

3. Bark dark brown or almost black, not separating in papery layers; branchlets and bud scales entirely glabrous; scales of the fruiting cones glabrous, woody *B. lenta*

3. Bark yellow or yellowish brown, often separating in papery layers; branchlets and bud scales at least sparsely hairy; scales of the fruiting cones pubescent, the tips thin *B. lutea*

2. Fruiting cones erect, spreading or hanging on slender peduncles; leaves mostly with 5 to 8 pairs of veins, *4*

4. Scales of fruiting cones glabrous; bark of trunk bright white, separating readily into thin layers; leaves ovate, rounded or shortly wedge-shaped at base, not long-acuminate *B. papyrifera*

4. Scales of fruiting cones pubescent or tomentose, *5*

5. Leaves triangular, abruptly long-acuminate, usually truncate at base, bright green and shining on both sides, except when very young; bark of trunk white (brownish in young plants), not readily separating in layers *B. populifolia*

5. Leaves rhombic-ovate, subacute at both ends, pubescent beneath at least on the veins; bark reddish brown, separating freely in large thin papery scales *B. nigra*

B. populifolia Marsh. Gray birch, old field birch. Dry woods and open fields, often becoming a weedlike tree on abandoned land; common.

B. papyrifera Marsh. White or paper birch. Rocky woods; throughout. Infrequent in the Hudson Valley except in a few cold swamps and on bluffs along the river, but increasing eastward and becoming almost a dominant tree in the second growth woods on the higher hills. The growing birch is gradually crowded out by white pine and hemlock, but a few trees sometimes persist, even in old stands.

B. nigra L. Red birch, river birch. Along the Hudson River and the lower reaches of the larger streams; rare, in the southern part of our area. Saugerties, Ulster County, whence reported by Torrey (1843), and later collected by Peck and by Muenscher (1936; Muenscher, *in lit.);* infrequent along the larger creeks at Pine Plains, according to Hoysradt; Crugers' Island, according to Muenscher (*in lit.*).

B. lenta L. Black birch, sweet birch. Moist or rocky woods; common throughout.

B. lutea Michx. f. Yellow birch. Rich woods and swamps; common especially eastward. Infrequent in the Hudson Valley, where the species is never abundant (figure 13).

B. pumila L. Open calcareous marshes; locally abundant. Miller Pond, Ancram, *1072;* marsh west of Croghan Hill; about 3 miles north of Ancramdale, *811;* Pine Plains, *Hoysradt* (GH, NY). The Croghan Hill locality was known to Hoysradt, and his specimens may have come from there. The species is thoroughly at home in these marshes, often reaching a height of 4.5 meters or more and fruiting freely.

5. **Alnus** Hill Alder

1. Leaves elliptic to ovate, usually rounded at base, downy beneath at least on the nerves, sharply and doubly serrate *A. rugosa*

1. Leaves obovate, acute or wedge-shaped at base, nearly smooth and sometimes slightly sticky beneath, minutely and almost regularly serrate. *A. serrulata*

A. **rugosa** (Du Roi) Spreng. Wet places in the open and along streams; common. Often a weedy species, taking over old fields.

A. **serrulata** (Ait.) Willd. About the margins of lakes, ponds, and in bogs; common.

FAGACEAE (Beech Family)

1. Staminate flowers in a small head on a drooping peduncle; nuts sharply triangular; bark of trunk smooth and light iron-gray, even in age — 1. **Fagus**

1. Staminate flowers in slender drooping catkins; nuts not triangular; bark in age rough, scaling or cracking, *2*

  2. Nut wholly inclosed in a hard prickly bur — 2. **Castanea**

  2. Nut (acorn) inclosed at base only, the bur (cupule) not prickly — 3. **Quercus**

1. **Fagus** L. Beech

F. **grandifolia** Ehrh. Rich or moist woods; common. Often gregarious and thus locally very abundant.

2. **Castanea** Hill Chestnut

C. **dentata** (Marsh.) Borkh. Woods; throughout. Formerly abundant in all woodlands. So far as known, all of the original trees have been killed by the chestnut blight fungus, *Endothia parasitica,* but seedlings and stump-sprouts are frequently seen. These may reach a diameter of several centimeters and may occasionally bear fruit before the disease again makes itself manifest.

3. **Quercus** L. Oak

1. Lobes of leaves obtuse, the ends of the lobes or teeth never bristle-pointed; fruit maturing the first year (white oaks), *2*

  2. Leaves usually deeply pinnatifid-lobed, or irregularly lobed, rarely shallowly lobed or merely toothed, *3*

    3. Leaves glabrous and glaucous beneath when mature; scales of the cup not awned — *Q. alba*

    3. Leaves pubescent or tomentose beneath when mature; upper scales of the cup long-awned, the cup thus fringed — *Q. macrocarpa*

  2. Leaves coarsely and regularly sinuate-dentate or serrate, not deeply lobed, *4*

    4. Fruit sessile or nearly so, *5*

      5. Leaves with 10 to 16 rounded teeth on each side — *Q. Prinus*

      5. Leaves with 3 to 7 acute teeth on each side — *Q. prinoides*

    4. Fruit long-peduncled; leaves usually densely white-tomentose beneath — *Q. bicolor*

1. Lobes or teeth of leaves acute and bristle-pointed (at least in youth); fruit maturing the second year (black oaks), *6*

  6. Mature leaves green on both sides, sometimes pubescent beneath, *7*

    7. Principal winter buds 6 to 12 mm. long, distinctly quadrangular, densely pubescent toward the tips; inner bark distinctly orange-colored; mature leaves usually somewhat pubescent beneath, at least in the axils of the veins — *Q. velutina*

    7. Principal winter buds mostly 5 mm. long or less; inner bark light pinkish or brownish; mature leaves glabrous beneath or nearly so, *8*

      8. Buds nearly terete, glabrous or nearly so, shining; longest lobes of the leaf blades about equaling the breadth of the blades between the lobes or shorter; cup of acorn usually saucer-shaped or flattish — *Q. borealis*

8. Buds usually slightly quadrangular, dull, somewhat pubescent; lobes of leaves often 2 to 6 times as long as the breadth of the blade between the lobes; cup of acorn deeper, usually with a conical base *Q. coccinea*

6. Mature leaves densely grayish-tomentose beneath *Q. ilicifolia*

Q. alba L. White oak. Woods; common throughout.

Q. macrocarpa Michx. Bur oak; mossy-cup oak. Borders of moist woods; infrequent or rare. Roadside near Hillsdale, *House 20594;* Copake Falls, *Britton et al.* (NY); reported from Kinderhook Lake by House (verbally) and seen near Stuyvesant Falls.

Q. Prinus L. Chestnut oak. In dry, usually rocky, woods; common. Scarce on calcareous soils.

Q. prinoides Willd. Dwarf chestnut oak. Bare shaly hillsides; infrequent, in the southern part of the area. Stuyvesant Falls, *5046* (USNA); Blue Hill, *596;* 1 mile northeast of Blue Stores, *3209, 3211;* north end of Fox Hill, Ancram, *3422.*

Q. bicolor Willd. Swamp white oak. Swamps and wet woods; frequent. Not reported from the northeastern part of the county.

Q. velutina Lam. Black oak. Dry woods; known from Stuyvesant Falls southward and southeastward; rather abundant on the partly metamorphosed shales of the Harlem Valley. About 1.5 miles east of Stuyvesant Falls, *3752;* 1 mile northeast of Blue Stores, *3215;* Upper Twin Pond, Elizaville, *3274;* 2 miles southwest of Hillsdale, *3549;* Robinson Pond, *3940;* 2 miles south of Copake, *3354.*

Q. borealis Michx. f. *(Q. rubra* of *Gray's Manual).* Red oak. Woods; common. In our area chiefly represented by var. **maxima** Ashe, but the gray oak, typical *Q. borealis,* appears with the variety and seems to be the commoner of the two in the hills of the region of metamorphic rocks.

Q. coccinea Muenchh. Scarlet oak. Dry woods; widely distributed, but apparently infrequent. Gallatin, near pond south of Taghkanic Lake, *House 20527;* Fowlers' Lake, *1667;* sandy woods north of Kinderhook, *1698.*

Q. ilicifolia Wang. Scrub oak. Dry hillsides and thickets, in rocky or sandy soil; rare in the Hudson Valley, but becoming common southeastward and forming dense stands on the higher hills of the towns of Hillsdale, Copake and Ancram. Unknown northeastward. Near Canticoke Swamp, *1700;* north of North Chatham, *House 20453;* island at Stuyvesant Falls, *619* (PENN); Blue Hill, *613* (PENN).

URTICACEAE[1] (NETTLE FAMILY)

1. Shrubs or trees, *2*

2. Fruit fleshy, edible, made up of an aggregate of the fleshy calyces of the pistillate flowers; leaves usually with 1 or 2 thumblike lobes; sap milky 3. **Morus**

2. Fruit a samara or small drupe; leaves not lobed; sap watery, *3*

3. Fruit a samara; flowers on branches of the preceding year 1. **Ulmus**

3. Fruit a drupe; flowers on branches of the current year 2. **Celtis**

1. Herbaceous plants, *4*

4. Leaves palmately 3- to 5-lobed; pistillate flowers in conelike spikes 4. **Humulus**

[1] Including *Ulmaceae, Moraceae* and *Cannabinaceae* of *Gray's Manual.*

4. Leaves not lobed, *5*
5. Leaves strictly alternate, *6*
6. Coarse herbs with large toothed leaves and stinging hairs 6. **Laportea**
6. Slender herbs with entire leaves; stinging hairs none 9. **Parietaria**
5. Leaves opposite, *7*
7. Plants glabrous, smooth and shining, the stem translucent 7. **Pilea**
7. Plants variously coarse-pubescent, *8*
8. Plants with stinging hairs; flower clusters in panicled spikes 5. **Urtica**
8. Plants with stinging hairs; flower clusters in simple axillary spikes 8. **Boehmeria**

1. **Ulmus** L. Elm

1. Inner bark mucilaginous; flowers subsessile, in dense clusters, not drooping; leaves very rough above *U. rubra*
1. Inner bark not mucilaginous; flowers slender-pedicelled, drooping; leaves smooth or slightly rough above, *2*
2. Branches often corky-winged; samaras pubescent all over *U. Thomasi*
2. Branches usually not corky-winged; samaras glabrous on both sides, the margins ciliate *U. americana*

U. americana L. American elm, white elm. Moist woods and swampy land, or in dry soil; common.

U. rubra Muhl. Slippery elm. Moist woods and along creeks; frequent in the Hudson Valley and well known in the Harlem Valley. Unknown northeastward except through a report by *Harrison* (1887) from Lebanon Springs. Copake, *Peck;* Copake Falls, *Britton et al.* (NY); 1.5 miles north of Kinderhook, *262;* east of Blue Hill, *House 22680;* north of Tivoli, *2723.*

U. Thomasi Sarg. Cork elm. Reported from Pine Plains by Hoysradt. There are in the vicinity of Kinderhook several trees having the twigs with the corky wings characteristic of this species. These, however, have never borne fruit, and other characters seem to indicate that they are merely abnormal individuals of *U. americana.*

2. **Celtis** L.

C. occidentalis L. Hackberry. Rocky bluffs and ridges; common on the shales and limestones of the Hudson Valley and at Copake; unknown elsewhere. Poelsburg, on river bluffs; limestone hill 3 miles north of Claverack; Mount Merino; Blue Hill; 2 miles east of Germantown.

3. **Morus** L.

M. rubra L. Red mulberry. Rich or moist wooded hillsides; infrequent. Apparently confined to the Hudson Valley. 3 miles north of Claverack, *1307;* Hudson, *Peck;* 1 mile east of Clermont, *3254.*

4. **Humulus** L.

H. Lupulus L. Hop. Occasionally escaped near dwellings. Hoysradt (1875-79) reports this species as "common . . . and certainly indigenous" at Pine Plains. It was found growing in a tidal marsh east of Crugers' Island, *2906,* and appearing as if native, but House (1924) says "probably never indigenous in this State."

5. **Urtica** L.

U. dioica L. (*U. procera* of *Gray's Manual*). Nettle. Thickets, roadsides and borders of woodlands; frequent. Our plant is var. **procera** (Muhl.) Wedd., according to Hermann (Am. Midl. Nat. 35: 777. 1946).

6. **Laportea** Gaud.

L. canadensis (L.) Gaud. Wood nettle. Swampy woods and cool ravines; frequent, especially eastward. Copake Falls, *Britton et al.* (NY); Hotaling Island, *Taylor 1384* (NY); along Mill Creek, Stuyvesant, *1812;* south of Columbiaville, *1506;* [Claverack, *Rev. A. P. Van Gieson* (V)].

7. **Pilea** Lindl.

P. pumila (L.) Gray. Richweed, clearweed. Wet, usually shady places; common throughout.

8. **Boehmeria** Jacq.

B. cylindrica (L.) Sw. False nettle. Swamps and wet woods; common.

9. **Parietaria** L.

P. pensylvanica Muhl. Dry ledges; apparently rare. Mount Lebanon and Kinderhook Lake, *House* (verbal reports); Magdalen Island, *2678.*

LORANTHACEAE (Mistletoe Family)

Arceuthobium Bieb.

A. pusillum Peck. Dwarf mistletoe. Sphagnum bogs; parasitic on *Picea mariana;* rare. Locally abundant at a bog southeast of Knickerbocker Lake, *2441,* and formerly abundant at Taplins' Pond, *2418.* The bog at Taplins' Pond has now been flooded, apparently through the activity of beavers.

SANTALACEAE (Sandalwood Family)

Comandra Nutt.

C. umbellata (L.) Nutt. Dry woods and hillsides; frequent. Most abundant in the dry rocky woods characterized by *Quercus Prinus, Vaccinium* spp., *Gaylussacia baccata* and *Hieracium venosum.*

ARISTOLOCHIACEAE (Birthwort Family)

Asarum L.

A. canadense L. Wild ginger. Rich moist woods and floodplains; common. Most abundant in calcareous regions.

POLYGONACEAE (Buckwheat Family)

1. Sepals 6, the 3 inner ones usually enlarged in fruit — 1. **Rumex**
1. Sepals 5, equal in fruit, *2*
  2. Leaves triangular-hastate; plants erect — 3. **Fagopyrum**
  2. Leaves not triangular-hastate, or, if so, the stem twining or climbing by prickles — 2. **Polygonum**

1. Rumex L. Dock

1. At least the lower leaves hastate with two spreading lobes at base of blade; sepals not enlarged in fruit; plants dioecious *R. Acetosella*
1. Leaves narrowed, truncate or cordate at base, not hastately lobed; three inner sepals much enlarged in fruit, *2*
  2. Inner sepals with long sharp spreading teeth on the margins *R. obtusifolius*
  2. Inner sepals entire or somewhat toothed, *3*
    3. Pedicels filiform, of nearly uniform thickness, not conspicuously reflexed, *4*
      4. Leaves lanceolate or linear-lanceolate, not crisped, subentire, pale green and glaucescent; pedicels jointed very near the base *R. mexicanus*
      4. Leaves lanceolate to oblong, dark green, not glaucescent; pedicels jointed ¼ to ⅓ their length above the base, *5*
        5. Leaves crenate, crisped on margins; pedicels with swollen joints *R. crispus*
        5. Leaves obscurely crenulate, scarcely crisped; pedicels obscurely jointed *R. orbiculatus*
    3. Pedicels gradually enlarged upwards, jointed at base, conspicuously reflexed *R. verticillatus*

R. Acetosella L. Sorrel. Dry fields, woods and hillsides; common. Frequently appearing as if indigenous.

R. mexicanus Meisn. Waste or swampy ground along the Hudson River; occasional. Nutten Hook, *Muenscher & Clausen 4636* (CU); flats between Hudson and Athens, *Muenscher & Clausen 4635* (CU); [south of Castleton, *House 24205*].

R. verticillatus L. Swamp dock. Immature plants from the swamps of Hotaling Island are apparently of this species, *3139*.

R. orbiculatus Gray. Great water dock. Open swampy ground and borders of ponds; local, throughout, except in the calcareous marshes of the Harlem Valley, where frequent. Waldorf Pond, *House 20955;* south of Mount Riga Station, *3373;* Pulvers Corners, *3872*.

R. crispus L. Curly dock. Waste places and fields, often in cultivated ground; a common weed.

R. obtusifolius L. Broad-leaved dock. In situations like those of the last; common.

2. Polygonum L.

1. Stems erect or reclining; not twining vines, *2*
  2. Stems not armed with prickles, *3*
    3. Flowers solitary or in small clusters in the axils of the leaves, *4*
      4. Stems and branches more or less terete; leaves flat, *5*
        5. Calyx in fruit 2 to 3.5 mm. long; margins of calyx-lobes white or reddish white; plants usually prostrate *P. aviculare*
        5. Calyx in fruit 3.5 to 5 mm. long; margins of calyx-lobes yellowish or yellowish red; plants erect *P. erectum*
      4. Branches rather sharply angled; leaves plicate *P. tenue*
    3. Flowers in terminal racemes or spikelike clusters, *6*
      6. Styles long and stiff, exserted and persistent on the achene; spikes very long and slender, rigid, greenish *P. virginianum*
      6. Styles short and soft, barely exserted and withering in fruit, *7*
        7. Leaf sheaths nearly or quite free from marginal cilia, *8*

8. Spikes several, often panicled; plants annual, in wet or dry soil, *9*
9. Peduncles strongly glandular-pubescent; spikes thick, erect, pink; leaves glabrous or sparingly strigose on the midrib beneath *P. pensylvanicum*
9. Peduncles smooth or obscurely glandular, *10*
10. Achenes 1.5 to 1.8 mm. wide; spikes slender, drooping, pinkish *P. lapathifolium*
10. Achenes mostly 2 to 2.5 mm. wide; spikes more or less erect, greenish *P. scabrum*
8. Spikes 1 or 2, rarely 3; plants aquatic or of marshes, with long perennial rootstocks rooting in the mud, *11*
11. Leaves elliptical, obtuse or short-acute; spikes 1.2 to 2.4 cm. long *P. amphibium*
11. Leaves lanceolate to ovate, usually distinctly acuminate; spikes 3 to 10 cm. long *P. coccineum*
7. Leaf sheaths bristly-ciliate on the margins, *12*
12. Sepals dotted with dark glands, *13*
13. Achenes with a dull surface, not glossy; internodes short, 2 to 4 cm. long; stems often reddish *P. Hydropiper*
13. Achenes shining; internodes longer, 3 to 8 cm. long; stems green or dull purplish, *14*
14. Plants decumbent at base and rooting at the nodes; achenes 3-angled *P. punctatum* var. *majus*
14. Plants from fibrous roots, not decumbent, rooting at few nodes or none; achenes mostly lenticular *P. punctatum* var. *confertiflorum*
12. Sepals not dotted with dark glands, *15*
15. Spikes dense, ovoid or short-cylindric; flowers dull pale greenish purple or greenish white; plants annual, often weedy, in wet or dry soil; leaves often with a purplish spot near the middle *P. Persicaria*
15. Spikes long and slender; flowers clear white or pink; plants perennial, with green leaves, growing in very wet soil *P. hydropiperoides*
2. Stems armed with hooked prickles; more or less reclining plants with sagittate or hastate leaves, *16*
16. Leaves sagittate *P. sagittatum*
16. Leaves broadly halberd-shaped (hastate) *P. arifolium*
1. Stems twining, vinelike; leaves broadly ovate, cordate at base, *17*
17. Nodes of the stem not bristly-ciliate, *18*
18. Angles of the calyx sharply keeled but not winged in fruit; achenes dull *P. Convolvulus*
18. Angles of the calyx conspicuously winged in fruit; achenes shining, *19*
19. Fruiting calyx 10 to 15 mm. long; achene 4 mm. long *P. scandens*
19. Fruiting calyx 5 to 7 mm. long; achene 2.6 to 3 mm. long *P. dumetorum*
17. Nodes of the stems conspicuously bristly-ciliate with reflexed bristles; angles of the calyx obscurely keeled *P. cilinode*

Section 1. **Avicularia**

P. aviculare L. Knotweed. Dooryards and waste ground; a common weed. Probably equally common throughout our area, but collected mostly from the Hudson Valley.

P. erectum L. In our area known only through a collection from north of Nassau Lake, *Muenscher & Clausen 4627* (CU).

P. tenue Michx. Dry shaly (sometimes sandy) hillsides and knolls; abundant and characteristic on the loose shales of the Hudson and Harlem Valleys, but not reported northeastward. 1 mile north of Kinderhook, on sandy knoll; north of Stuyvesant Falls; Nutten Hook; northeast of Fowlers' Lake; Mount Merino; Blue Hill; Silvernails; 2 miles southwest of Hillsdale.

Section 2. Tovara

P. virginianum L. (*Tovara virginiana* of *Gray's Manual*). Moist soil in woods and thickets and along streams; common throughout.

Section 3. Persicaria Smartweed

P. amphibium L. Rooted in shallow water around the margins of lakes and ponds; common. The plant occurs both with floating leaves and later, when water level is lowered, in a terrestrial form. Kinderhook Lake; Queechy Lake; No Bottom Pond; Spring Lake, Red Hook; Robinson Pond; Shaver Pond. The form with foliaceous margins on the ocreae (*P. Hartwrightii* Gray) occurs locally in grassy marshes; 1 mile southeast of Fowlers' Lake, *1436;* 2 miles southeast of Taghkanic, *3361.*

P. coccineum Muhl. Swamps and borders of lakes and ponds; infrequent. Kinderhook Lake, *House 11309;* Nassau Lake, *Muenscher & Clausen 4480* (CU); [3 miles north of Ancramdale, *3894*].

P. scabrum Moench. A collection by Peck, from Kinderhook Lake, labeled *P. lapathifolium,* has the thick, erect, greenish spikes and broad achenes of *P. scabrum* and is apparently of this species. Otherwise unknown.

P. lapathifolium L. Moist soil, borders of lakes and streams, often in swampy places; infrequent. Kinderhook, along Kinderhook Creek, *4023;* Stuyvesant Falls, *2384;* Taghkanic Lake, *2008;* Robinson Pond, *House 20605.*

P. pensylvanicum L. In moist soil, in open swamps, ditches and cultivated ground; frequent. In the Hudson Valley often abundant and weedy; distribution eastward poorly known. In our area represented only by var. **laevigatum** Fern.

P. Persicaria L. Moist places, in waste and cultivated grounds; very common. The most abundant "weedy" smartweed in our area.

P. Hydropiper L. Moist soil, waste or cultivated ground; probably more common, but known from relatively few localities. 4 miles north of Lebanon Springs, *3787;* 1 mile north of Kinderhook; Brace Mountain.

P. hydropiperoides Michx. Wet places near streams and ponds; infrequent. Hudson River, south of Castleton, *House 24184;* Wynkoops' Pond, village of Kinderhook, *1679;* Robinson Pond, *3953.*

P. punctatum Ell. Wet or swampy places; common. Especially conspicuous and abundant in the tidal marshes of the Hudson River. Represented in our area by var. **confertiflorum** (Meisn.) Fassett. The var. *majus* (Meisn.) Fassett (*P. robustius* of *Gray's Manual*) was reported from the Hudson Estuary by Muenscher (1937), but the report is unverified, and Fassett (Brittonia 6: 374, 378, 1948) does not report this variety from the estuary except in the vicinity of New York.

Section 4. Tiniaria Bindweeds

P. Convolvulus L. Waste and cultivated grounds; a common weed. Also

found in rocky woods and other natural habitats, where appearing entirely indigenous.

P. cilinode Michx. Thickets and woods, usually in rocky places. Common eastward, especially at higher elevations; rare in the Hudson Valley. Austerlitz, *688, 1970;* 2 miles south of Copake, along Bashbish Brook, *3349;* Valatie, along Kinderhook Creek, *1893;* [Claverack, *Rev. A. P. Van Gieson* (V)].

P. scandens L. Thickets near ponds and streams; climbing over bushes; frequent in the Hudson Valley. Not reported elsewhere. Poelsburg, *2367* (PENN); Waldorf Pond, *House 20916;* 1 mile south of Kinderhook, *4017.*

P. dumetorum L. (*P. cristatum* of *Gray's Manual*). Rocky woods; infrequent. Curtis Mountain, *2144* (PENN); Blue Hill, *2185;* 2 miles southeast of Churchtown, *3499.*

Section 5. **Echinocaulon** Tear thumbs

P. sagittatum L. Wet places in swampy woods and thickets and along streams; common.

P. arifolium L. With the preceding and about equally common; throughout. In our area represented only by var. **pubescens** (Keller) Fern.

3. **Fagopyrum** Mill.

F. sagittatum Gilib. Buckwheat. Frequently escaped from cultivation and often persistent and self-sown for some years.

CHENOPODIACEAE (Goosefoot Family)

1. Leaves linear, rigid, prickle-pointed — 5. **Salsola**
1. Leaves flat, linear-lanceolate or broader, not prickly, *2*
  2. Flowers monoecious or dioecious — 4. **Atriplex**
  2. Flowers perfect, *3*
    3. Fruiting calyx horizontally winged, *4*
      4. Leaves narrowly linear-lanceolate, entire; flowers axillary — 3. **Kochia**
      4. Leaves broad, coarsely toothed; flowers paniculate — 2. **Cycloloma**
    3. Fruiting calyx not winged, herbaceous, greenish — 1. **Chenopodium**

1. **Chenopodium** L.

1. Plants glandular, more or less aromatic, *2*
  2. Leaves pinnately lobed; flowers in open forking cymes which are arranged in loose spikes — *C. Botrys*
  2. Leaves toothed or nearly entire; flowers in dense axillary clusters — *C. ambrosioides*
1. Plants neither aromatic nor glandular, often mealy, *3*
  3. Plants bright green throughout; panicles very loose and open, nearly naked — *C. gigantospermum*
  3. Leaves white-mealy on the lower surface, *4*
    4. Plants low, spreading; sepals not keeled in fruit; some of the seeds vertical — *C. glaucum*
    4. Plants tall, erect; sepals somewhat keeled in fruit (when dry); all the seeds horizontal — *C. album*

C. gigantospermum Aellen (*C. hybridum* var. *gigantospermum* of *Gray's Manual*). Woods and thickets; infrequent. Brainard, *House 18419*; crevices in shale rock southwest of West Ghent, *4004.*

C. album L. Pigweed. Fields, gardens and woods; a common weed, often appearing as if indigenous.

A specimen from Nassau, *2142*, has been referred by Wahl to the newly described *C. Foggii* Wahl.* This species differs from true *C. album* by the "readily separable pericarp and thin, narrowly ovate leaves, entire or with basal lobes."

C. ambrosioides L. Mexican tea. Waste places along the Hudson River; infrequent. Nutten Hook, *4502;* flats between Hudson and Athens, *Muenscher & Clausen 4639* (CU).

C. Botrys L. Dry gravelly situations; infrequent. 2 miles east of Valatie, *1887*.

C. glaucum L. Mud flats south of Hudson, *Muenscher & Clausen 4640* (CU). Otherwise unknown.

2. **Cycloloma** Moq.

C. atriplicifolium (Spreng.) Coult. Tumbleweed. At one time forming an extensive growth on the sand flats between Stuyvesant and Nutten Hook, *4057*. Several acres of the dredged-up sand were covered thickly by this recent immigrant from the Western States (figure 14); much less abundant in recent years (McVaugh, 1947).

3. **Kochia** Roth

K. scoparia (L.) Schrad. Frequently cultivated, and occasional as an escape. Niverville, *House 13398*.

4. **Atriplex** L.

A. patula L. Weed in cultivated grounds; rare. Reported by Hoysradt from the "village roads" of Pine Plains; *House 11315,* from Niverville, approaches the var. **hastata** (L.) Gray.

5. **Salsola** L.

S. Kali L. "Russian thistle." Sand and dry places along the Hudson River, where frequent. Seemingly introduced along the New York Central Railroad. In our area represented only by var. **tenuifolia** G. F. W. Mey.

AMARANTHACEAE (Amaranth Family)

1. Calyx of pistillate flowers none; tall erect plants of marshes 1. **Acnida**
1. Calyx with 2 to 5 lobes or distinct sepals; weedy species of waste and cultivated ground 2. **Amaranthus**

1. **Acnida** L.

A. cannabina L. Abundant in tidal mud along the Hudson River. Otherwise unknown. Mouth of Muitzes Kill; Poelsburg; mouth of Mill Creek, Stuyvesant; Nutten Hook (CU); Hudson (CU); Cheviot; Magdalen Island.

2. **Amaranthus**† L.

1. Flowers in small close axillary clusters; stamens and sepals 2 or 3; leaves small, spatulate-oblong or obovate, 1 to 7 cm. long; plants diffuse or prostrate, *2*

*Bartonia 27: 19-20. 1954.

† Correctly spelled *Amarantus,* following the original orthography of Linnaeus, but almost always *Amaranthus* by recent authors.

2. Plants diffuse; utricle wrinkled; leaves toward ends of branches much reduced *A. albus*
2. Plants prostrate; utricle smooth; upper leaves scarcely reduced *A. graecizans*

1. Flowers in dense panicles terminating the branches; stamens and sepals 5; leaves larger, petioled, ovate-lanceolate, 8 to 15 cm. long; plants rough, erect, *3*
3. Branches of the panicle stout, 8 to 20 mm. wide; sepals of the pistillate flowers obtuse, often notched at tip and mucronate *A. retroflexus*
3. Branches of the panicle slender, about 5 mm. wide above the middle; sepals of the pistillate flowers acute, mucronate *A. hybridus*

A. retroflexus L. Pigweed. Weed in gardens and other cultivated or waste grounds; frequent.

A. hybridus L. Pigweed. Situations like the last; common.

A. albus L. Tumbleweed. Cultivated or waste places, often in sandy soil; a common weed.

A. graecizans L. Waste places; rare. Introduced from the west. Railroad yards, Hudson, *4755* (USNA).

PHYTOLACCACEAE (Pokeweed Family)

Phytolacca L.

P. americana L. Pokeweed. Woods and wooded banks, often in recent clearings; frequent in the Hudson Valley, but not reported eastward.

ILLECEBRACEAE[1] (Knotwort Family)

1. Leaves awl-shaped; stipules none; calyx urn-shaped, indurated in fruit **1. Scleranthus**
1. Leaves flat; stipules present; calyx open, of separate thin sepals **2. Paronychia**

1. Scleranthus L. Knawel

S. annuus L. A weed in fields and waste places, usually in sandy soil; frequent.

2. Paronychia Mill.

1. Plants pubescent; flowers nearly sessile; plants low and spreading *P. fastigiata*
1. Plants glabrous or essentially so; flowers stalked; plants slender and erect *P. canadensis*

P. fastigiata (Raf.) Fern. Sandy soil along Kinderhook Creek about 1 mile south of Kinderhook, *4015;* 2 miles east of Spencertown. Otherwise unknown.

P. canadensis (L.) Wood. Dry rocky woods and banks; common.

NYCTAGINACEAE (Four-O'clock Family)

Oxybaphus L'Hér.

O. nyctagineus (Michx.) Sweet (*Mirabilis nyctaginea* of *Gray's Manual*). Dry sandy places, or in cinders; rather frequent along the Hudson River;

[1] Included in *Caryophyllaceae* in *Gray's Manual.*

unknown elsewhere. Seemingly introduced along the New York Central Railroad.

AIZOACEAE (Carpetweed Family)

Mollugo L.

M. verticillata L. Carpetweed. Weed in sandy soil, usually in cultivated grounds; frequent.

PORTULACACEAE (Purslane Family)

1. Plants prostrate; leaves many, small, obovate or wedge-shaped, alternate; flowers yellow; capsule opening by a lid — 1. Portulaca
1. Plants weakly ascending; leaves 2, elongated, 2.5 to 15 cm. long, opposite; flowers pink or whitish; capsules opening by three valves — 2. Claytonia

1. Portulaca L.

P. oleracea L. Pussley. A common weed in gardens and waste places.

2. Claytonia L.

1. Leaves linear-lanceolate, elongated, 7 to 15 cm. long — *C. virginica*
1. Leaves oblong-lanceolate or spatulate-oblong, 2.5 to 5 cm. long *C. caroliniana*

C. virginica L. Spring beauty. Moist woods and alluvial banks; infrequent. Widely distributed in the Hudson and Harlem Valleys, but only very locally abundant. 3 miles northeast of Stuyvesant, *370;* south of Niverville, *519;* Stuyvesant Falls, *Iva Allen;* 2 miles south of Claverack, *4373;* [Claverack, *Rev. A. P. Van Gieson* (V)].

C. caroliniana Michx. Broad-leaved spring beauty. Moist woods, at the higher elevations northeastward; rare. Mount Lebanon, *House 16152;* Lebanon Springs, *4293.*

CARYOPHYLLACEAE (Pink Family)

1. Sepals distinct or nearly so, more or less spreading, *2*
  2. Stipules present; leaves whorled, thread-shaped — 5. Spergula
  2. Stipules wanting; leaves opposite, *3*
    3. Capsule splitting into valves; plant glabrous or the stems pubescent in lines, scarcely viscid, *4*
      4. Leaves linear, thread-shaped; plants low and tufted; styles alternate with the sepals — 3. Sagina
      4. Leaves linear to broader; if linear, the plants not low and tufted; styles opposite some or all of the sepals, *5*
        5. Petals entire, not 2-parted — 4. Arenaria
        5. Petals 2-parted or wanting — 1. Stellaria
    3. Capsule curved-cylindric, opening by a row of teeth at apex; petals 2-parted; plants hairy, usually viscid — 2. Cerastium
1. Sepals united into a tubular calyx, *6*
  6. Calyx naked at base, without an involucre of bracts, *7*
    7. Styles 5; calyx 10-nerved, *8*
      8. Sepals with long herbaceous tips; styles opposite the petals — 6. Agrostemma
      8. Sepals not long-tipped; styles alternate with the petals — 8. Lychnis
    7. Styles 2 or 3, *9*
      9. Styles 3; calyx 10-nerved — 7. Silene

9. Styles 2; calyx obscurely nerved 9. **Saponaria**
6. Calyx with an involucre of bracts at base 10. **Dianthus**

1. **Stellaria** L.

1. Stems and flower stalks glabrous, *2*
2. Flower bracts leaflike, resembling the upper leaves *S. calycantha*
2. Flower bracts scalelike, soon scarious, at least on margins, *3*
3. Leaves linear, subacute at both ends; seeds smooth; inflorescence soon becoming lateral *S. longifolia*
3. Leaves lanceolate, broadest just above the base; seeds minutely roughened; inflorescence terminal *S. graminea*
1. Stems hairy in lines *S. media*

S. calycantha (Ledeb.) Bong. Cool moist places; apparently rather frequent in western Massachusetts: Mount Washington, *Knowlton & Schweinfurth* (NEBC). In our area represented only by var. **isophylla** (Fern.) Fern.

S. longifolia Muhl. Moist grassy places; distribution not well known. New Britain, *House 23645;* Kinderhook, *974.* "Silvernail Marsh, rare," according to Hoysradt (1874b).

S. graminea L. Moist grassy places; frequent. Malden Bridge, near Bachus Pond, *921;* New Lebanon, *House 21309;* 1 mile northwest of Brainard, *House 21406.*

S. media (L.) Cyrillo. Chickweed. Weed in lawns, cultivated grounds and woods; frequent.

2. **Cerastium** L.

1. Petals 8 to 10 mm. long; plants perennial; leaves rather stiff, with fascicles of leaves in the axils *C. arvense*
1. Petals mostly 5 to 7 mm. long; leaves soft, without axillary fascicles, *2*
2. Plants perennial; lower pedicels not over 15 mm. long; petals about equaling the sepals *C. vulgatum*
2. Plants annual; lower pedicels 15 to 50 mm. long; petals longer than the sepals, often twice as long *C. nutans*

C. arvense L. Bare rocky slopes on the higher hills to the southeastward; rare. Cedar Mountain, *3454;* Washburn Mountain, *4210* (GH); Stissing Mountain, *Hoysradt* (PENN); [Millerton, *House 22411*].

C. vulgatum L. Mouse-ear chickweed. A common weed in woods and cultivated grounds. In our area represented only by var. **hirsutum** Fries.

C. nutans Raf. Harvey Mountain, near Massachusetts-New York line, *Hoffmann* (NEBC); shaly quarry bank about 1 mile northeast of Stuyvesant, *505.* Reported from Copake Falls (Burnham, 1913; Hoffmann, 1922); Pine Plains (Hoysradt); Schodack (Wibbe, in Gordinier & Howe, 1894).

3. **Sagina** L.

S. procumbens L. Springy places and wet rocks, at elevations above 300 m. in the eastern part of the area. West of Berry Pond, Hancock, *3773;* 2 miles east of Austerlitz, *682* (PENN); Bashbish Falls, *Dobbin 934.*

4. **Arenaria** L.

1. Leaves 10 to 20 mm. long, elliptical, blunt; plants perennial *A. lateriflora*
1. Leaves 4 to 8 mm. long, ovate, acute; plants annual *A. serpyllifolia*

A. lateriflora L. Wet meadows, often in more or less calcareous situations; also in woods (Lebanon Springs, *2406*). Widely distributed, but infrequent and only locally abundant. North of Kinderhook, *955;* east of Clermont, along Roeliff Jansen Kill, *4352;* calcareous meadow 3 miles north of Ancramdale, *814*.

A. serpyllifolia L. Dry gravelly or rocky places, weedy; infrequent. Valatie; Blue Hill; 2 miles southeast of Germantown.

5. **Spergula** L.

S. arvensis L. Spurry. Weed in cultivated ground; rare. Stephentown Center, *House 21683;* east of Blue Hill, according to House.

6. **Agrostemma** L.

A. Githago L. Corncockle. Weed in and near grain fields; infrequent. Reported as early as 1836 from Troy (Wright & Hall) and from Kinderhook in 1839 (Woodworth); probably much less frequent now than formerly.

7. **Silene** L.

1. Calyx strongly bladdery-inflated, papery; plant perennial, glabrous, glaucous *S. Cucubalus*
1. Calyx not inflated except by the enlarging capsule; plants pubescent or viscid or both, *2*
  2. Plant annual, tall, erect, 20 to 90 cm. high, *3*
    3. Plant nearly glabrous, a part of each internode covered by a dark sticky substance; leaves linear-lanceolate, acute; corolla 2 to 4 mm. broad or wanting *S. antirrhina*
    3. Plant sticky-pubescent; lower leaves large and spatulate; corolla white, large, 15 to 25 mm. broad *S. noctiflora*
  2. Plant perennial, tufted, the stems 10 to 20 cm. high, strongly sticky-pubescent, at least above; flowers pink, about 2.5 cm. across *S. caroliniana*

S. Cucubalus Wibel. Bladder campion. Weed of fields and roadsides; locally abundant. Occasionally appearing as if indigenous, as at Green River, in rocky woods, *1515*.

S. antirrhina L. Dry rocky woods and banks; infrequent. Often rather weedy. Abundant on Stissing Mountain; 1 mile east of Pulvers, Ghent; Poelsburg; North Chatham; Germantown; Clermont; Boston Corners.

S. noctiflora L. A specimen in the Beck collection, now at the New York State Museum, collected at New Lebanon in 1823 by *G. H. Lawrence*, is apparently of this species.

S. caroliniana Walt., var. **pensylvanica** (Michx.) Fern. Dry woods, on shaly or schistose rocks in the southern part of our area. Frequent in the town of Copake: Cedar Mountain, *137* (PENN); north of Robinson Pond, *843;* Tom Hill, on limestone, *826;* 2 miles south of Copake, *3355;* reported by Hoysradt as "common on slate hills north of Pine Plains," and should be sought in Ancram and Gallatin.

8. **Lychnis** L.

L. alba Mill. White campion. Roadside weed; occasional. [*Lychnis Floscuculi* L. was reported from Old Chatham upon the authority of Sereno Watson

by C. L. Shear (Bull. Torrey Bot. Club 18: 60. 1891). This showy red-flowered species with 4-lobed petals has not since been reported from our area. Shear's note was called to my attention by Dr. House].

9. Saponaria L.

1. Calyx terete *S. officinalis*
1. Calyx strongly 5-angled, becoming 5-winged *S. Vaccaria*

S. officinalis L. Bouncing Bet. Waste places and roadsides; common throughout. Most abundant along the Hudson River, near the New York Central Railroad.

S. Vaccaria L. Known only through a collection from Greendale, *Livingston,* June 22, 1925.

10. Dianthus L.

D. Armeria L. Deptford pink. Waste places, especially about old yards and roadsides; frequent.

CERATOPHYLLACEAE (Hornwort Family)

Ceratophyllum L.

C. demersum L. Hornwort. Ponds and sluggish streams, including the Hudson River; common. Fruits but rarely.

NYMPHAEACEAE (Water-lily Family)

1. Leaves with a deep notch or sinus on 1 side; petals many, in several rows; ovary 1, with several compartments; flowers white, pink or yellow, *2*
  2. Petals yellow, small and stamenlike; sepals petallike, yellow (sometimes with a red blotch at base) 2. **Nuphar**
  2. Petals white or pinkish, showy; sepals green 3. **Nymphaea**
1. Leaves peltate, without a notch at the side; petioles, lower side of young leaves, and inflorescence strongly gelatinous; petals 3 or 4 purplish; pistils 4 to 18, separate 1. **Brasenia**

1. Brasenia Schreb.

B. Schreberi Gmel. Ponds; rare. Reported from Chatham by Eaton (1818), from Pine Plains by Hoysradt and from Malden Bridge by Wibbe (in Gordinier & Howe, 1894). Taghkanic Lake, *2023;* Sutherland Pond, Chatham, *2136;* Spring Lake, Red Hook, *2747;* Bells' Pond, *3302.*

2. Nuphar Sm.

1. Flowers 2.5 to 3 cm. in diameter or less; stigma 6- to 10-rayed; leaves 3.5 to 10 cm. long, the basal lobes nearly as long as the body *N. microphyllum*
1. Flowers 4 to 6 cm. in diameter; stigma 12- to 24-rayed; leaves 15 to 30 cm. long, the basal lobes about half as long as the body, *2*
  2. Leaves more or less erect, the blades upright, with an open sinus; sepals green-tinged inside at the base *N. advena*
  2. Leaves not erect, the blades floating; sinus narrow, often nearly closed; sepals red-tinged inside at base *N. advena* var. *variegatum*

N. microphyllum (Pers.) Fern. Ponds and slow streams; rare. Berry Pond, Hancock, *3775;* 1 mile north of Madalin, *2765*; Poelsburg, *Taylor 1410* (NY).

N. advena (Ait.) Ait.f. "Yellow water lily." Tidal mud along the Hudson River, where very abundant, often forming pure stands many acres in extent (figure 15). It is, in our area, strictly an estuarine species; the common yellow "water lily" of lakes seems always to be the var. *variegata.* There seems, however, to be no clear-cut line between the two. On the tidal flats of the river are occasional shallow depressions containing water even at low tide, and here occur plants with the floating leaves and narrow leaf sinuses of the *variegata* type, while a few feet away are the plants with upright leaves and broad sinuses which are so characteristic of the habitat.

Var. **variegatum** (Engelm.) Engelm. (*N. variegatum* of *Gray's Manual*). Ponds and sluggish streams; common. Probably found in every natural permanent lake or pond in our area; also in Taghkanic Creek near New Forge, *3496.*

3. Nymphaea L.[1]

1. Flowers 7 to 12 (15) cm. in diameter, sweet-scented; sepals often purplish outside; petals generally with an ovate apex; inner filaments narrower than the anthers; seeds 1.5 to 2.3 mm. long; leaves usually purplish beneath and indistinctly veined; branches of the rhizome not constricted at base *N. odorata*

1. Flowers 10 to 23 cm. in diameter, scentless or nearly so; sepals green; petals generally rounded at apex; filaments broader than the anthers; seeds 2.8 to 4.4 mm. long; leaves green beneath, vein; branches of the rhizome constricted at base, tuberlike, readily detachable *N. tuberosa*

N. odorata Ait. "White water lily." Margins of ponds and sluggish streams, including the Hudson River; common.

N. tuberosa Paine. "Locally common in . . . Kinderhook Lake" (Muenscher, Suppl. 24th Ann. Report N. Y. State Conserv. Dept. 247, 1935).

MAGNOLIACEAE (Magnolia Family)

1. Leaves lobed and appearing as if cut off abruptly at apex; corolla greenish yellow, marked with orange; pistils flat and scalelike, indehiscent, in an elongated cone **1. Liriodendron**

1. Leaves oblong, acute at apex, not lobed; corolla glaucous-green tinged with yellow (in our species); pistils cohering into a fleshy cone, the individual carpels splitting at maturity, exposing the berrylike seed **2. Magnolia**

1. Liriodendron L.

L. Tulipifera L. Tulip tree. Rich woods; common in the Hudson Valley, but decreasing northward to Kinderhook, *1027.* Occurs infrequently in the Harlem Valley; Copake Falls, *Britton et al.* (NY). Not definitely known elsewhere, but reported by Harrison from Lebanon Springs, where it is found at present in cultivation.

2. Magnolia L.

M. acuminata (L.) L. Cucumber tree. Swampy woods about 4 miles north of Lebanon Springs, whence reported by Torrey (1843), Harrison (1887) and McVaugh (1936c). Otherwise unknown in eastern New York except in cultivation.

[1] The key to this genus is taken over nearly word for word from Wiegand & Eames (1926), as I have had no opportunity to see *N. tuberosa* in the field.

RANUNCULACEAE (Buttercup Family)

1. Woody climbing vines with opposite leaves; styles enlarged and plumose in fruit 13. **Clematis**

1. Plants herbaceous, or, if woody, not as above, *2*

2. Plants shrubby; wood yellow; leaves pinnate 4. **Xanthorhiza**

2. Plants herbaceous, *3*

3. Fruit a follicle or many-seeded berry, *4*

4. Petals present; leaves compound, *5*

5. Petals large, spurred; flowers 5 cm. long 7. **Aquilegia**

5. Petals smaller, not spurred, equaling or shorter than the sepals, *6*

6. Leaves ternately decompound, *7*

7. Flowers in elongated spikelike racemes; fruit a follicle 6. **Cimicifuga**

7. Flowers in short racemes; fruit a berry 5. **Actaea**

6. Leaves 3-foliolate, evergreen 3. **Coptis**

4. Petals absent; leaves simple, *8*

8. Calyx large, showy, bright yellow; flowers cymose; leaves reniform, crenate 2. **Caltha**

8. Calyx small, greenish white; leaves sharply incised-lobed; flowers solitary 1. **Hydrastis**

3. Fruit an achene, *9*

9. Sepals and petals both present, the petals more showy, usually yellow 11. **Ranunculus**

9. Petals absent; sepals often petaloid, never yellow, *10*

10. Cauline leaves all alternate, ternately decompound; flowers small and numerous, panicled 12. **Thalictrum**

10. Cauline leaves opposite, whorled or apparently none; flowers few; sepals large, showy, *11*

11. Cauline leaves whorled, distant from the flowers, lobed and incised, or ternately decompound, *12*

12. Achenes strongly ribbed, mostly 4 to 15 in number; leaves ternately decompound 10. **Anemonella**

12. Achenes not ribbed, numerous (at least more than 15); leaves palmately lobed, incised or divided 8. **Anemone**

11. Cauline leaves apparently none, reduced to an involucre just beneath the petaloid calyx; basal leaves with three entire lobes 9. **Hepatica**

1. Hydrastis Ellis

H. canadensis L. Goldenseal. A plant of rich soils of the interior. In eastern New York known only from a patch of woods south of Hudson, *Weatherby* (GH); reported from Hudson by Stebbins (1830).

2. Caltha L.

C. palustris L. Cowslip, "Marsh marigold." Swampy woods and meadows; common.

3. Coptis Salisb.

C. groenlandica (Oeder) Fern. Goldthread. Moist, often swampy or sphagnous woods; common at the higher elevations eastward and northeastward, but rare in the Hudson Valley, where it is now confined to a few small areas. Kinderhook (PENN); Niverville (PENN); [Claverack, *Rev. A. P. Van Gieson* (V); North Chatham, *House 21165*].

4. **Xanthorhiza** Marsh.

X. simplicissima Marsh. Yellowroot. In woods in an abandoned arboretum 1 mile north of Lebanon Springs, *3661*. Now thoroughly established and covering nearly an acre of ground.

5. **Actaea** L.

1. Pedicels stout, in flower 3 to 6 mm. long; fruit white (rarely dull purple) *A. alba*

1. Pedicels slender, in flower 8 to 15 mm. long; fruit crimson, shining (rarely white) *A. rubra*

A. alba (L.) Mill. (*A. pachypoda* of *Gray's Manual*). White baneberry. Woods; common.

A. rubra (Ait.) Willd. Red baneberry. Woods; rather infrequent, but widely distributed.

6. **Cimicifuga** L.

C. racemosa (L.) Nutt. Bugbane. Rich woods; locally abundant in the Hudson and Harlem Valleys. Kinderhook Lake; Kinderhook; Tom Hill, Copake, on limestone soil, *835* (figure 16).

7. **Aquilegia** L.

A. canadensis L. Wild columbine. Dry rocky banks and woods; common. Apparently most abundant on the shales and limestones of the Hudson Valley.

8. **Anemone** L.

1. Plants tall, usually not less than 25 cm. tall, often 60 to 90 cm., 2- to several-flowered, *2*

2. Cauline leaves sessile; achenes not woolly; fruiting head spherical *A. canadensis*

2. Cauline leaves petioled; achenes densely woolly; fruiting head cylindrical *A. virginiana*

1. Plants smaller, 8 to 20 cm. tall, 1-flowered; achenes glabrous; cauline leaves petioled *A. quinquefolia*

A. virginiana L. Dry woods and banks; common. The report of a related species, *A. riparia,* from Pine Plains (Taylor, 1915) is apparently based upon a collection by G. M. Wilber now at the New York Botanical Garden. The plant in question appears to be *A. virginiana.*

A. canadensis L. Wet meadows and along streams; common in the Hudson Valley; reported from Mount Lebanon (House); unknown elsewhere eastward.

A. quinquefolia L. Wood anemone. Sandy and rich woods; common.

9. **Hepatica** Mill.

1. Lobes of the leaves and involucral bracts rounded *H. americana*

1. Lobes of the leaves and involucral bracts acute *H. acutiloba*

H. americana (DC.) Ker. Hepatica. Dry woods; common.

H. acutiloba DC. Dry calcareous woods; known only from the towns of Austerlitz, Canaan and New Lebanon, at elevations of 300 m. or more; there locally abundant. Reported by Hoysradt (1874b) as occurring "sparingly on Stissing."

10. **Anemonella** Spach

A. thalictroides (L.) Spach. Rue anemone, windflower. Dry woods; common. Most abundant in the Hudson Valley, where it is often the most conspicuous feature of the spring woodlands.

11. **Ranunculus** L. Crowfoot, buttercup

1. Flowers white; aquatics with dissected leaves *R. longirostris*
1. Flowers yellow, *2*
  2. Leaves linear to lanceolate or narrowly oblong, undivided, entire or barely toothed, *3*
    3. Stems upright, hollow, rather conspicuously jointed; leaves 4 to 10 cm. long, scarcely denticulate; achene with a long narrow subulate beak *R. ambigens*
    3. Stems filiform, creeping and rooting at the nodes; leaves 0.6 to 2.5 cm. long, nearly entire; achene very minutely beaked *R. reptans*
  2. Most of the leaves cleft or divided, not narrow and elongated, *4*
    4. Submersed (or stranded) aquatics with the underwater leaves finely dissected; leaves all repeatedly 3-forked, the emersed ones usually roundish in outline *R. flabellaris*
    4. Terrestrial plants, often in wet places but not submersed aquatics, *5*
      5. Flower small, 1 cm. across or less, *6*
        6. Plant glabrous, *7*
          7. Basal leaves all 3-lobed or 3-parted; stems stout, hollow; heads oblong; achenes very numerous *R. sceleratus*
          7. Basal leaves suborbicular, crenate, not lobed; stems slender; heads subglobose, the achenes few in number *R. abortivus*
        6. Plants hirsute, *8*
          8. Achene with long recurved beak; head of fruit subglobose *R. recurvatus*
          8. Achene beak straight or nearly so; head distinctly oblong *R. pensylvanicus*
      5. Flowers large, mostly 1.5 to 2.5 cm. across, *9*
        9. Style (forming the "beak" of the fruit) elongated, 1 mm. or more long in fruit, *10*
          10. Stems ascending or procumbent and rooting at the nodes, often with long flowerless branches; plants commonly growing in wet or swampy places, *11*
            11. Achenes 3 to 3.5 mm. broad, with a stout straight beak more than half the length of the achene *R. septentrionalis*
            11. Achenes 2 to 2.5 mm. broad, with the somewhat curved beak half the length of the achene or less; flowers usually double (in ours) *R. repens*
          10. Stems tufted from a dense cluster of roots, more or less upright and not creeping; plants of dry woodlands and clearings, *12*
            12. Roots much thickened, fleshy; leaves mostly pinnately cleft or divided, with oblong or linear lobes or divisions *R. fascicularis*
            12. Roots scarcely thickened; leaves palmately or pedately 3-cleft or divided, the divisions broad *R. hispidus*
        9. Style short, recurved, less than 1 mm. long in fruit; large coarse weedy plants with all the leaf divisions sessile and palmate *R. acris*

R. longirostris Godr. White water crowfoot. Lakes and ponds; rare. Waldorf Pond, *906;* Knickerbocker Lake, *1191;* Copake Lake, *3425.*

R. flabellaris Raf. Yellow water crowfoot. Muddy ditches and on exposed mud in swamps and around small ponds; sometimes in shallow water; infrequent. 2 miles southeast of Stuyvesant Falls, *2028;* 2 miles south of Ghent, *4013;* 2 miles south of Germantown, *3161;* 3 miles north of Ancramdale, *3348.*

R. reptans L., var. **ovalis** (Bigel.) T. & G. Abundant on the muddy shores of No Bottom Pond, *1953.* Otherwise unknown.

R. ambigens S. Wats. Ditches, in mud; rare. Flats northeast of Kinderhook, *1564;* 1 mile south of Germantown, *3317.* Otherwise unknown.

R. abortivus L. Moist woods; common.

R. sceleratus L. Wet places; rare. A coastal or salt-marsh species, known in our area only from the shore of the Hudson River south of Hudson, *1603* (PENN).

R. recurvatus Poir. Moist woods, common.

R. acris L. Tall meadow buttercup. Fields, pastures and roadsides; common.

R. pensylvanicus L.f. Moist, often rich, soil; widely distributed but not common. Copake Falls, *Britton et al.* (NY); Becraft Mountain, *2236;* Kinderhook, *1409;* Knickerbocker Lake, *House 23706.*

R. septentrionalis Poir. Swamp buttercup. Swampy woods and wet borders of streams and ponds; common.

R. hispidus Michx. Early woods buttercup. Wooded hillsides; common in the Hudson Valley; occurs in the Harlem Valley; otherwise unknown. Poelsburg, *374;* 2 miles east of Kinderhook, *453* (PENN); 3 miles north of Claverack, *555* (PENN); 2 miles north of Chatham, *4103* (GA); Pine Plains, *Hoysradt* (PENN); Millerton, *House 22420.* Represented in our area only by var. **falsus** Fern.

R. repens L., forma **pleniflorus** (Fern.) Fern. in House. Double buttercup. Cultivated, and occasionally established as an escape, as in the "vlei" at Kinderhook, *680.*

R. fascicularis Muhl. Dry shaly hillsides in the Hudson Valley; rare. Abundant at the following localities: 1 mile north of Stuyvesant Falls, *4139;* Mount Merino, *4071* (GH); Blue Hill, *616.*

12. Thalictrum L.

1. Filaments capillary, drooping; petioles of the stem leaves well developed; flowering period late April to early June — *T. dioicum*

1. Filaments club-shaped, thickest just below the anthers, spreading or ascending until after the flowering period; petioles of the stem leaves almost none; flowering period late June to August — *T. polygamum*

T. dioicum L. Early meadow rue. Dry woods; common. The name "meadow rue," as applied to this species, is a misnomer, as it is characteristically a plant of dry wooded hillsides.

T. polygamum Muhl. Meadow rue. Wet meadows and swamps and along streams; common.

13. Clematis L.

1. Flowers white, about 2 cm. across, in cymose panicles — *C. virginiana*

1. Flowers purple, 5 to 7.5 cm. across, usually solitary — *C. verticillaris*

C. virginiana L. Woodbine. Moist hedges and thickets; common.

C. verticillaris DC. Purple clematis, virgin's-bower. Rocky woods; widely distributed, on various soils, but infrequent. Mount Alander, *1772;* east of

Boston Corners, *2274;* Douglas Knob, New Lebanon, *3628;* 3 miles north of Castleton, *3979;* Old Chatham, *637;* 3 miles north of Claverack, *1306.* The first three specimens cited above are from acid soils, on schistose rocks; the Castleton locality is in a rich woods, on shale; the last two are on limestone rocks.

BERBERIDACEAE (Barberry Family)

1. Plants shrubby, spiny, with yellow flowers and yellow wood; fruit a red few-seeded berry **1. Berberis**

1. Plants herbaceous, *2*

2. Flowers solitary, nodding, white; leaves of the flowering stems 2, deeply lobed, 1-sided; fruit a large fleshy berry, yellow when ripe **3. Podophyllum**

2. Flowers racemose, yellowish green, small; leaf 1, ternately compound; fruit soon splitting, exposing the two fleshy blue drupelike seeds. **2. Caulophyllum**

1. Berberis L.

B. vulgaris L. European barberry. Dry woods and hillsides; very common on the shales and clays of the Hudson Valley, especially near Hudson; elsewhere occasional.

2. Caulophyllum Michx.

C. thalictroides (L.) Michx. Blue cohosh. Rich woods; frequent. Most abundant in calcareous situations. No Bottom Pond, *478;* 2 miles west of Red Rock, *4166* (GA); Green River, *1543;* Ashley Hill, Chatham, *4087* (GH); Stuyvesant Falls, *507.*

3. Podophyllum L.

P. peltatum L. May apple, mandrake. Moist woods; common in the Hudson Valley; otherwise unknown except from Perry Peak, Canaan, at an elevation of about 450 meters, *House 21179.*

MENISPERMACEAE (Moonseed Family)

Menispermum L.

M. canadense L. Moonseed. Woods and thickets, in dry or moist soil; frequent in the Hudson Valley, unknown elsewhere. Poelsburg, *2252;* Waldorf Pond, *House 20934;* 3 miles north of Claverack, on limestone talus, *1294;* Tivoli, *2690;* [Claverack, *Rev. A. P. Van Gieson* (V)]; Magdalen Island, *2684.*

LAURACEAE (Laurel Family)

1. Leaves with one or two thumblike lobes, or entire; all three sorts of leaves usually on the same plant; flowers in terminal peduncled racemes, appearing with the leaves; fruit ovoid, blue, on a fleshy red pedicel **1. Sassafras**

1. Leaves entire; flowers in dense subsessile axillary clusters, appearing before the leaves; fruit bright red **2. Lindera**

1. **Sassafras** Nees

S. **albidum** (Nutt.) Nees. Sassafras. Dry woods and fields; common in the Hudson and Harlem Valleys; unknown from the higher elevations eastward and northeastward.

2. **Lindera** Thunb.

L. **Benzoin** (L.) Blume. Spicebush. Moist or swampy woods; common.

PAPAVERACEAE (Poppy Family)

1. Petals 8 to 12, white; plants scapose, with 1 flower and 1 leaf from a fleshy rootstock with reddish orange juice 1. **Sanguinaria**

1. Petals 4, yellow; plants with leafy stems and yellow juice 2. **Chelidonium**

1. **Sanguinaria** L.

S. **canadensis** L. Bloodroot. Moist woods; common.

2. **Chelidonium** L.

C. **majus** L. Celandine. Moist woods and banks; locally abundant, especially near dwellings and towns.

FUMARIACEAE[1] (Fumitory Family)

1. Corolla with two petals prolonged into spurs at the base of the flower, the enlargement of the petals sometimes slight, *2*

2. Plant a delicate climbing herbaceous vine with thrice-pinnate leaves; petals white or purplish, united into a spongy persistent corolla; flowers numerous, in a panicle 2. **Adlumia**

2. Plants low, erect, acaulescent, with ternately compound leaves; petals little united, deciduous, white to cream-colored or tinged with rose; flowers in racemes of 4 to 10 1. **Dicentra**

1. Corolla with but 1 petal spurred at base, deciduous after flowering, purplish green or rose-colored, with yellow tips 3. **Corydalis**

1. **Dicentra** Bernh.

1. Flowers 2-spurred at base, not fragrant; stem from a fleshy, loosely scaly bulb *D. Cucullaria*

1. Flowers merely cordate at base, not spurred, fragrant; stem from a cluster of yellow pealike tubers *D. canadensis*

D. **Cucullaria** (L.) Bernh. Dutchman's-breeches. Rich woods; rather infrequent, but locally abundant. South of Kinderhook, *4237;* Ashley Hill, Chatham, *4088* (GA); Stuyvesant Falls, *Iva Allen;* Hollowville, *4063;* "common" at Pine Plains, according to Hoysradt; also reported from near Clermont.

D. **canadensis** (Goldie) Walp. Squirrel corn. Known only from New Lebanon, *Iva Allen,* May 2, 1896.

[1] Included in *Papaveraceae* in *Gray's Manual.*

2. **Adlumia** Raf.

A. fungosa (Ait.) Greene. Woods; rare. Abundant in Bashbish Gorge, in clearings, *3566;* 3 miles east of Elizaville, *3287;* Washburn Mountain, *3464;* 1 mile east of Pulvers, Ghent, *1500.* At all the above stations the plants occur in soils underlain by acid rocks rather than in calcareous soils as usually reported. Unknown in the Hudson Valley, although reported from Hudson (Stebbins, 1830).

3. **Corydalis** Medic.

C. sempervirens (L.) Pers. Rocky banks and exposed rocky hilltops, in acid soil. Unknown in the Hudson Valley; rather frequent elsewhere, but only locally abundant. Curtis Mountain, Nassau; Ashley Hill, Chatham; Brainard; Green River; Hillsdale; 2 miles east of Elizaville; Stissing Mountain; east of Boston Corners.

CRUCIFERAE (Mustard Family)

1. Fruit not more than three times as long as wide, *2*
  2. Flowers white, greenish white or cream-colored, *3*
    3. Fruit turgid, scarcely at all flattened, ovoid or subglobose; basal leaves coarse, undivided, 15 to 30 cm. long — 5. **Armoracia**
    3. (See also third "3") Fruit flattened parallel with the broad partition — 1. **Berteroa**
    3. Fruit flattened at right angles to the narrow partition, *4*
      4. Pods obcordate — 2. **Capsella**
      4. Pods orbicular or oval — 6. **Lepidium**
  2. Flowers bright or pale yellow — 3. **Rorippa**
1. Fruit four to many times as long as wide, *5*
  5. Flowers yellow or cream-yellow, *6*
    6. Apex of fruit beyond the valves beaklike, 2 mm. long or more; petals 6 to 20 mm. long, *7*
      7. Pods indehiscent, spongy; petals with dark veins — 16. **Raphanus**
      7. Pods dehiscent, thin-walled; petals clear yellow, *8*
        8. Apex of fruit beyond the valves more than 4 mm. long, or, if shorter, the leaves thin and often hairy, with dentate lobes — 15. **Brassica**
        8. Apex of fruit beyond the valves less than 4 mm. long; leaves semi-succulent, glabrous, with entire or crenate lobes — 11. **Barbarea**
    6. Apex of fruit beyond the valves 1 mm. long or less; petals 3 to 10 mm. long, *9*
      9. Leaves entire or nearly so; stem hairs vertical, attached by the middle — 8. **Erysimum**
      9. Leaves pinnatifid; stem hairs, if any, not as above, *10*
        10. Leaves waxy, shining, glabrous, shallowly crenate, the terminal lobes usually obtuse — 11. **Barbarea**
        10. Leaves usually thin and veiny, more or less sharply toothed, the terminal lobes commonly acute, *11*
          11. Fruiting pedicels thick and stout; valves of the pod with 1 to 3 ribs — 9. **Sisymbrium**
          11. Fruiting pedicels slender; valves of the pod veinless — 3. **Rorippa**
  5. Flowers pure white or purple, rarely greenish white or yellowish white, *12*
    12. Fruit indehiscent, thick and spongy, beaked — 16. **Raphanus**
    12. Fruit dehiscent, not spongy nor fleshy, *13*
      13. Leaves palmately divided and cleft — 14. **Dentaria**
      13. Leaves pinnatifid or undivided, *14*

14. Petals 15 to 20 mm. long, purple (rarely white); plants coarse; leaves 9 to 15 cm. long, sharply toothed 10. **Hesperis**
14. Petals small, not exceeding 14 mm. in length, white (rarely purple-tinged), *15*
15. Pods flattened, *16*
16. Pubescence, if present, of simple hairs; plants, if glabrous, lacking sagittate-clasping leaves 13. **Cardamine**
16. Pubescence, if present, at least in part of branched hairs; plants, if glabrous, with sagittate-clasping leaves 12. **Arabis**
15. Pods terete or angular, not flattened, *17*
17. Pods angular, the valves conspicuously keeled; plants with odor of onions; leaves deltoid-ovate, simple, not lobed 7. **Alliaria**
17. Pods terete; leaves pinnatifid, not onion-scented 4. **Nasturtium**

1. Berteroa DC.

B. incana (L.) DC. Roadside weed 1 mile east of Kinderhook, *4766* (USNA). Otherwise unknown.

2. Capsella Medic.

C. Bursa-pastoris (L.) Medic. Shepherd's-purse. Cultivated and waste ground; a common weed.

3. Rorippa Scop.

1. Pods narrowly linear, 6 to 12 mm. long *R. sylvestris*
1. Pods ellipsoid to short-cylindrical or almost globose, mostly 5 mm. long or less *R. islandica*

R. sylvestris (L.) Bess. Creeping yellow water cress. East Nassau, *House 21943*. Introduced from Europe.

R. islandica (Murr.) Borbas. Yellow water cress. Wet places along streams; common.

4. Nasturtium R. Br.

N. officinale R. Br. Water cress. In streams and springs; locally abundant.

5. Armoracia Gaertn.

A. lapathifolia Gilib. Horseradish. Commonly cultivated and occasionally escaping to ditches and alluvial grounds.

6. Lepidium L.

1. Stem leaves clasping at base; plant soft-downy *L. campestre*
1. Stem leaves not clasping; plant nearly or quite glabrous *L. virginicum*

L. campestre (L.) R. Br. Waste places; local, weedy. Blue Hill, *608*; 1 mile north of Stuyvesant; Brainard; North Chatham.

L. virginicum L. "Peppergrass." Roadsides, fields and cultivated grounds; common and weedy.

7. **Alliaria** Adans.

A. officinalis Andrz. Garlic mustard. Roadsides and cultivated ground; occasional.

8. **Erysimum** L.

E. cheiranthoides L. Garden weed, Kinderhook, *5108* (USNA); 1 mile west of Ancramdale, *3393*. Reported from Shekomeko Creek by Hoysradt.

9. **Sisymbrium** L.

1. Pods 1 to 1.5 cm. long, strongly appressed to the stem *S. officinale*
1. Pods 6 to 10 cm. long, spreading *S. altissimum*

S. officinale (L.) Scop. Hedge mustard. Waste and cultivated ground; a common weed.

S. altissimum L. Tumble mustard. Waste places; infrequent. Miller Pond, Ancram, *House 23685;* railroad yards, Hudson, *4753* (USNA).

10. **Hesperis** L.

H. matronalis L. Dame's rocket. Roadsides and along streams; occasional, as an escape from cultivation.

11. **Barbarea** R. Br.

1. Flowers racemose even during anthesis; pods erect or ascending on spreading pedicels *B. vulgaris* var. *arcuata*
1. Flowers corymbosely aggregated at summit of the stem in anthesis; pods strongly appressed on erect or ascending pedicels *B. vulgaris*

B. vulgaris R. Br. Winter cress. Cultivated and moist grounds; frequent. With us represented chiefly by var. **arcuata** (Opiz) Fries. Typical **B. vulgaris** is occasional.

12. **Arabis** L.

1. Basal leaves conspicuously pinnatifid; seeds oblong or elliptical, wingless; plants mostly 10 to 30 cm. high *A. lyrata*
1. Basal and cauline leaves entire, toothed or lobed, not pinnatifid; seeds orbicular, more or less winged; plants at maturity mostly 30 to 90 cm. high, *2*
  2. Stem leaves clasping at base, *3*
    3. Leaves hairy; pods closely appressed to the stem *A. hirsuta*
    3. Leaves glabrous, somewhat glaucous; pods widely spreading or somewhat drooping *A. laevigata*
  2. Stem leaves narrowed to a sessile base, not clasping; pods very flat and broad, 4 mm. wide, scythe-shaped, hanging *A. canadensis*

A. lyrata L. Rocky ledges and outcrops; common on the shales and limestones of the Hudson Valley; less common or local elsewhere. Washburn Mountain; Brace Mountain; Nutten Hook; Stuyvesant Falls; Blue Hill; Rogers Island.

A. hirsuta (L.) Scop. Rocky calcareous ledges; locally abundant. Canaan Center, *2315;* Tom Hill, Copake, *830*; 3 miles north of Ancramdale, *3335*; 1 mile southwest of West Ghent, *3295;* Pine Plains, *Hoysradt* (NY). Represented in our area by var. **pycnocarpa** (M. Hopkins) Rollins.

A. laevigata (Muhl.) Poir. Rich or moist woods or on ledges; frequent.

A. canadensis L. Sicklepod. Dry woods; frequent in the Hudson Valley, on shales and limestones; rare eastward. West Ghent, *3294;* Blue Hill, *2174;* 1.5 miles southeast of Clermont, *3236;* Magdalen Island, *2689.*

13. Cardamine L.

1. Leaves simple; plant with tuberous-thickened base of stem and rhizomes *C. bulbosa*

1. Leaves pinnatifid; base of stem and rhizomes slender, not tuberous-thickened, *2*

2. Plants of swamps, streams and wet grounds; leaflets of the cauline leaves oblong, tending to be confluent along the rachis *C. pensylvanica*

2. Plants of dry, usually rocky soil; leaflets of the cauline leaves narrow, nearly linear, not confluent along the rachis *C. parviflora*

C. bulbosa (Schreb.) BSP. Wet places, margins of swamps and streams; frequent in the Hudson Valley; unknown elsewhere. Kinderhook Lake, *398;* Kinderhook, *175* (PENN); 2 miles north of Claverack, *4374* (GA); 2 miles north of Mellenville, *4363;* Taghkanic Creek, at New Forge, *4392* (GH); Pine Plains, *Hoysradt* (PENN).

C. pensylvanica Muhl. Springy places and margins of streams; common.

C. parviflora L. Rocky ledges, on schist and quartzite; frequent eastward, at elevations greater than 300 m. Canaan, *3593;* Green River, *1516;* Washburn Mountain, *3463;* 1 mile west of Boston Corners, *3423.* Represented in our area by var. **arenicola** (Britt.) O. E. Schulz.

14. Dentaria L.

1. Rootstock long and continuous, not breaking up into separate tubers; cauline leaves 2, subopposite; leaflets ovate, coarsely toothed *D. diphylla*

1. Rootstock breaking up into a series of spindle-shaped tubers; cauline leaves usually 3, whorled or nearly so; leaflets oblong-linear, conspicuously incised-toothed *D. laciniata*

D. diphylla Michx. Rich woods; common.

D. laciniata Muhl. Pepper-root. Rich woods; common, but rather local and often very abundant in the localities where found.

"**D. laciniata** × **diphylla**" House. Locally very abundant, as at Poelsburg, *4193.* It seems best to include the various peculiar plants, occurring where the two species grow together, in this category (see House, *1924,* p. 369, and Wiegand & Eames, 1926, p. 232); this includes *D. maxima* Nutt., and probably *D. incisifolia* Eames and *D. anomala* Eames.

15. Brassica L. Mustard

1. Upper cauline leaves with a broad clasping base; plants glaucous, glabrous or essentially so *B. campestris*

1. Upper cauline leaves narrowed at base; plants not glaucous, somewhat hairy *B. Kaber*

B. campestris L. (*B. Rapa* of *Gray's Manual*). Waste places and dumps; abundant on dumps at Hudson, *4758* (USNA).

B. Kaber (DC.) L. C. Wheeler. Summer mustard. A troublesome weed of grain fields, especially in oats; throughout.

Brassica nigra (L.) Koch, the black mustard, *B. hirta* Moench and *B. juncea* (L.) Coss., all introduced species, have been found in the Hudson Valley but have not yet been definitely recorded from our area.

16. Raphanus L.

R. Raphanistrum L. Wild radish, "mustard." Cultivated fields and waste grounds; a common weed.

CAPPARIDACEAE (Caper Family)

Polanisia Raf.

P. graveolens Raf. Clammyweed. Sand and gravel bars in the larger streams of the Hudson Valley; frequent. Kinderhook, along Kinderhook Creek, *1248;* Valatie, *1886;* Hotaling Island, *3148;* between Hudson and Athens, *Muenscher & Clausen 4654* (CU).

SARRACENIACEAE (Pitcher-plant Family)

Sarracenia L.

S. purpurea L. Pitcher plant. Bogs; abundant in suitable situations in sphagnum (acid) bogs; occurs also in calcareous situations. Knickerbocker Lake, *1998;* Kinderhook Lake, *Brown 24;* south of Niverville, *868;* Fowlers' Lake, *718;* 2 miles north of Mellenville, in swampy woods, *4372* (GA); Miller Pond, Ancram, *3120;* [Claverack, *Rev. A. P. Van Gieson* (V)].

DROSERACEAE (Sundew Family)

Drosera L. Sundew

1. Leaf blades orbicular or broader than long — *D. rotundifolia*
1. Leaf blades spatulate, tapering into the petiole — *D. intermedia*

D. rotundifolia L. Sphagnum bogs; there abundant. Rare in the Hudson Valley, due at least in part to the scarcity of suitable habitats; increasingly frequent eastward. 4 miles north of Kinderhook (PENN); Niverville; Berry Pond, Hancock; Fowlers' Lake; Canaan Center; Mud Pond, Gallatin; north of Stephentown.

D. intermedia Hayne. Sphagnum bogs; locally abundant. Bog southeast of Knickerbocker Lake, *2148*; Taplins' Pond, *2421* (PENN); 3 miles southeast of Harlemville, *1904* (PENN); Mud Pond, Gallatin, *3283*.

CRASSULACEAE (Orpine Family)

1. Plant not fleshy; carpels united, forming a 5-locular capsule; petals usually none — 1. **Penthorum**
1. Leaves thick and fleshy; carpels 3 to 5, separate; petals present, *2*
  2. Small tufted annual growing on muddy shores, 1 to 8 cm. high; flowers solitary, axillary, greenish white; stamens 3 or 4 — 2. **Tillaea**
  2. Creeping or erect perennial plants of dry soil; flowers in cymes or 1-sided inflorescences; stamens 8 to 10 — 3. **Sedum**

1. Penthorum L.[1]

P. sedoides L. Ditch stonecrop. Wet places; common.

2. Tillaea L.

T. aquatica L. Tidal mud at Saugerties, Ulster County, *Muenscher & Curtis 5744.* To be looked for along the estuary in our area.

[1] Frequently transferred to the *Saxifragaceae,* as in *Gray's Manual.*

3. Sedum L.

1. Flowers yellow; leaves closely imbricated, thick-ovate, nearly terete *S. acre*
1. Flowers white to pink; leaves broad, *2*
2. Plant 7 to 15 cm. high; lower leaves whorled in 3's, cuneate-obovate, 12 to 25 mm. long; petals white *S. ternatum*
2. Plant 40 to 70 cm. high; leaves alternate, ovate, mostly 25 to 50 mm. long; petals purplish *S. triphyllum*

S. acre L. Mossy stonecrop. Shaly ledges; thoroughly naturalized just northeast of Stuyvesant Falls, *998.* Seen also at Nutten Hook, on sand flats.

S. ternatum Michx. Wild stonecrop. Well established and spreading in a lawn at Spencertown, *755.*

S. triphyllum (Haw.) S. F. Gray *(S. purpureum* of *Gray's Manual).* Live-forever. Roadsides or in woods; occasional as an escape from cultivation.

SAXIFRAGACEAE (Saxifrage Family)

1. Shrubs, with simple leaves, *2*
2. Leaves alternate; fruit a berry 8. **Ribes**
2. Leaves opposite; fruit a capsule 7. **Deutzia**
1. Low or tall herbs, *3*
3. Leaves large, decompound 6. **Astilbe**
3. Leaves simple, *4*
4. Peduncle scapelike, 1-flowered; plants glabrous, with the basal leaves rounded or cordate, entire 1. **Parnassia**
4. Flowers in racemes or panicles or axillary, not solitary on naked peduncles; leaves not entire, *5*
5. Petals none; bracts rounded, leaflike; weak-stemmed succulent herbs of wet woodlands 5. **Chrysosplenium**
5. Petals present; bracts not leaflike, *6*
6. Petals pinnatifid; capsule with two equal valves 4. **Mitella**
6. Petals entire, *7*
7. Capsule bilocular, 2-beaked 2. **Saxifraga**
7. Capsule unilocular, 2-valved, the valves very unequal 3. **Tiarella**

1. Parnassia L.

P. glauca Raf. "Grass of Parnassus." Calcareous marshes in the Hudson and Harlem Valleys; abundant, in suitable situations. 4 miles north of Kinderhook, *171* (PENN); Copake Falls, *Britton et al.* (NY); Miller Pond, Ancram, *3123;* 3 miles north of Ancramdale, *806;* swamp 2 miles south of Boston Corners, *1663;* Pulvers Corners, *3842* (figure 17).

2. Saxifraga L.

1. Sepals reflexed; petals small, greenish to reddish, about equaling the calyx; plants 30 to 60 cm. tall *S. pensylvanica*
1. Sepals ascending, not reflexed; petals white, exceeding the calyx; plants 10 to 30 cm. tall *S. virginiensis*

S. pensylvanica L. Swamp saxifrage. Deep swampy woods, or less often in wet meadows; frequent eastward, but rare in the Hudson Valley. Brainard, *House 21365;* Canticoke Swamp, *1746;* 2 miles southeast of North Chatham, *1146;* 1.5 miles north of Kinderhook, *977;* No Bottom Pond, *484;* Canaan Center, *1044;* 2 miles south of Copake Lake, *2603;* 1.5 miles south of Ancramdale, *3386.*

S. virginiensis Michx. Early saxifrage. Rocky ledges and outcrops; **common.**

3. **Tiarella** L.

T. cordifolia L. False miterwort. Rich woods and swamps; common eastward. Infrequent in the Hudson Valley; south of Niverville, *391* (PENN); Bachus Pond, *927;* Chatham, *Iva Allen;* Old Chatham, *624;* [Claverack, *Rev. A. P. Van Gieson* (V)].

4. **Mitella** L.

1. Stems bearing two opposite, subsessile leaves; leaves acutely lobed; petals white *M. diphylla*
1. Stems usually leafless above the base; leaves rounded, scarcely lobed; petals greenish *M. nuda*

M. diphylla L. Miterwort. Rocky woods; common. Abundant throughout.

M. nuda L. Cool boggy woods, in moss. In our area known only from 1 mile east of Canaan, 4268, and from Pine Plains, *Hoysradt,* May 20, 1878 (PENN).

5. **Chrysosplenium** L.

C. americanum Schwein. Rocky brooks and margins of swamps; common eastward, but rare in the Hudson Valley. North Chatham, *306;* No Bottom Pond, *481;* Spencertown, *4131* (GA); 3 miles northwest of Ancram, *383* (PENN).

6. **Astilbe** Hamilton

A. biternata (Vent.) Britt. False goatsbeard. Native of the southeastern United States; well naturalized and spreading in an abandoned arboretum north of Lebanon Springs, *3667.*

7. **Deutzia** Thunb.

D. scabra Thunb. Commonly cultivated, and said to be established along a creek near Copake Falls, *Burnham.*

8. **Ribes** L.

1. Peduncles 1- to 4-flowered; pedicels not jointed beneath the ovary, the mature fruit not breaking from the pedicel; plants with spines at the nodes, *2*
  2. Calyx tube longer than the lobes; ovary and berry usually prickly; leaves pubescent, almost velvety beneath *R. Cynosbati*
  2. Calyx tube equaling the lobes; ovary and berry not prickly; leaves somewhat pubescent or nearly glabrous beneath *R. hirtellum*
1. Flowers several in elongate racemes; pedicel jointed beneath the ovary, the fruit breaking from the pedicel; plants without nodal spines, *3*
  3. Leaves with resinous particles on the lower surface; bracts longer than the pedicels; fruit black *R. americanum*
  3. Leaves without resinous particles on the lower surface, *4*
    4. Ovary glandular-pubescent; fruit black; stems, at least the younger ones, densely bristly *R. lacustre*
    4. Ovary glabrous; fruit red; stems not bristly *R. sativum*

R. Cynosbati L. Wild gooseberry. Rocky woods and banks; frequent. Rather abundant on the shales of the Hudson Valley, and apparently less so elsewhere.

R. hirtellum Michx. Swamp gooseberry. Known only from the calcareous marshes of the Harlem Valley; Pulvers Corners, *4455.* Reported by Hoysradt (1874b) as "common in cold swamps."

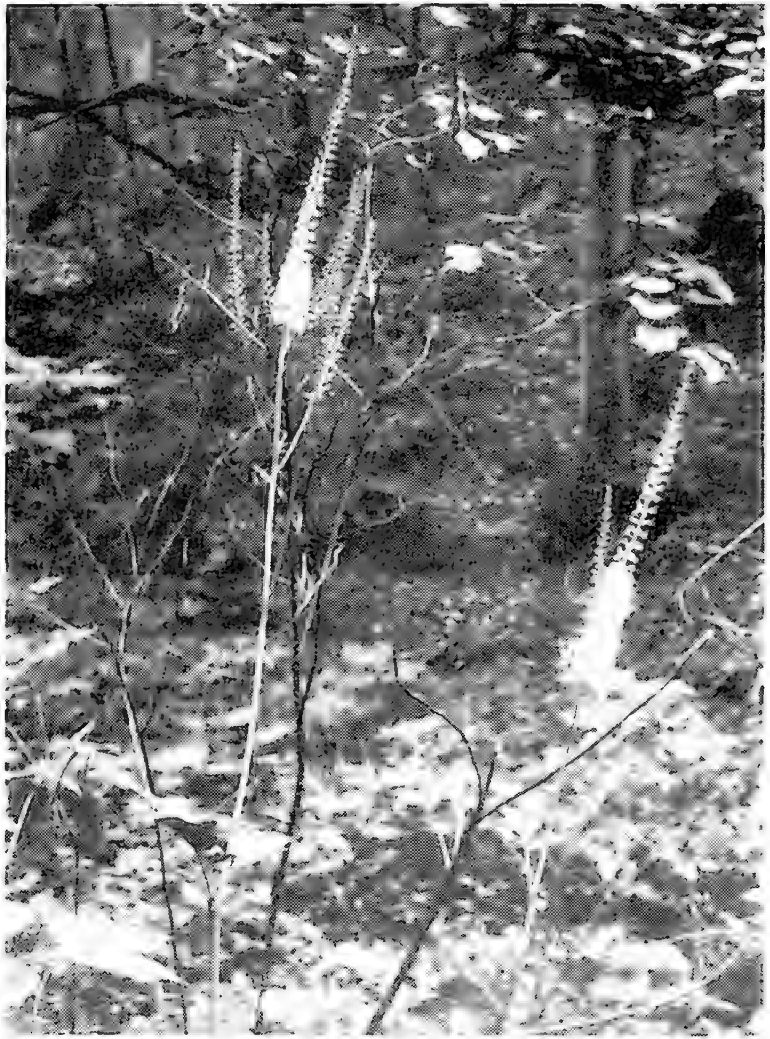

Figure 16. *Cimicifuga racemosa* in a moist woodland just north of Kinderhook. The flowering spikes are more than 30 cm. in length.

Figure 17. A calcareous bog association west of the Post Road School, Kinderhook. The large white flowers are those of *Parnassia glauca,* and below them may be seen the leaves of *Sarracenia purpurea* and flowers of *Lobelia Kalmii.* The leaves of *Potentilla fruticosa* are in the background.

Figure 18. *Potentilla tridentata* in a crevice in the schistose rocks at the summit of Washburn Mountain, Copake. The plants are about 10 cm. high or less.

R. americanum Mill. Wild black currant. Swampy woods and thickets; frequent. Most abundant in the Hudson Valley.

R. lacustre (Pers.) Poir. Cool rocky woods; common in the northern part of the State, but rare in our area. Known only from a gorge west of Berry Pond, Hancock, *3784*, and from the gorge of Bashbish Brook, at an elevation of about 250 m., *4226A*.

R. sativum (Reichenb.) Syme. Red garden currant. Occasionally escaped from cultivation, as along the Kline Kill near Arnolds' Mill, *4109*.

HAMAMELIDACEAE (Witch Hazel Family)

1. Tree with deeply 5- to 7-lobed, star-shaped leaves 1. **Liquidambar**
1. Tall shrub with obovate or oval, wavy-toothed unlobed leaves 2. **Hamamelis**

1. Liquidambar L.

L. Styraciflua L. Sweet gum. Native in southeastern New York, but doubtless always introduced in our area. Chatham, according to Eaton (1818); Crugers' Island, *2947*.

2. Hamamelis L.

H. virginiana L. Witch hazel. Woods; common. The witch hazel flowers in late autumn, when the leaves are falling.

PLATANACEAE (Plane Tree Family)

Platanus L.

P. occidentalis L. Sycamore, buttonwood. Banks of streams, or occasionally elsewhere; frequent.

ROSACEAE (Rose Family)

1. Ovary inferior; trees or shrubs with fleshy fruit; carpels 2 to 5, fused in the axis of the receptacle, *2*
  2. Mature carpels papery or leathery (texture that of an apple "core"), *3*
    3. Leaves pinnate 12. **Sorbus**
    3. Leaves simple, *4*
      4. Locules of the ovary as many as the styles; flowers in umbels or corymbs, *5*
        5. Inflorescence simple 14. **Malus**
        5. Inflorescence compound 13. **Aronia**
      4. Locules of the ovary, at least in fruit, twice as many as the styles; flowers in racemes 15. **Amelanchier**
  2. Mature carpels very hard and bony; plant usually thorny 16. **Crataegus**
1. Ovary superior, *6*
  6. Carpel 1; fruit a drupe; trees or shrubs with simple leaves 17. **Prunus**
  6. Carpels 2 to several, distinct, *7*
    7. Fruit a 2- to many-ovuled follicle; plants shrubby, *8*
      8. Leaves pinnate 3. **Sorbaria**
      8. Leaves simple, *9*
        9. Carpels bladdery-inflated in fruit; leaves lobed 1. **Physocarpus**
        9. Carpels not inflated; leaves not lobed 2. **Spiraea**
    7. Fruit an achene or drupe (the individual fruits sometimes contained in a fleshy receptacle); carpels 1-ovuled; plants shrubby or herbaceous, *10*

10. Carpels permanently inclosed in the receptacle, *11*
11. Receptacle dry and woody, with hooked spines, plants herbaceous **6. Agrimonia**
11. Receptacle fleshy; plants shrubby **11. Rosa**
10. Carpels not permanently inclosed in the receptacle, *12*
12. Fruit a dry achene (receptacle may be enlarged and fleshy, simulating a fruit); bractlets present between the sepals, *13*
13. Styles elongated in fruit, hooked, persistent, often plumose **8. Geum**
13. Styles not elongated in fruit, *14*
14. Receptacle much enlarged in fruit, pulpy, red or white; flowers white **5. Fragaria**
14. Receptacle in fruit dry, not or scarcely enlarged, *15*
15. Achenes few, mostly 2 to 6; plants scapose **7. Waldsteinia**
15. Achenes numerous; plants caulescent **4. Potentilla**
12. Fruit a small drupe; bractlets between the sepals none, *16*
16. Drupelets many, fleshy; leaves compound or lobed **10. Rubus**
16. Drupelets 5 to 10, nearly dry; leaves simple, cordate, crenate; plant herbaceous, creeping **9. Dalibarda**

1. Physocarpus Maxim.

P. opulifolius (L.) Maxim. Ninebark. Rocky ledges and swamps along the Hudson River; common. Otherwise unknown except from isolated stations at Chatham, *1028,* and North Chatham, *House 20454.*

2. Spiraea L.

1. Leaves glabrous or sparingly pubescent beneath; petals white or pinkish *S. latifolia*
1. Leaves densely white or brownish tomentose beneath; petals rose-colored (rarely white) *S. tomentosa*

S. latifolia (Ait.) Borkh. Meadowsweet. Open swamps and hillsides; common. Abundant, especially eastward, in old fields and pastures; often with the following species.

S. tomentosa L. Pink spiraea. Situations similar to the preceding species, in dry or wet soil; common, especially eastward.

3. Sorbaria A. Br.

S. sorbifolia (L.) A. Br. Cultivated; occasionally established on roadsides and by old houses; West Taghkanic, *1092.*

4. Potentilla L.

1. Calyx and petals reddish purple *P. palustris*
1. Petals yellow or white, *2*
2. Stems distinctly shrubby, 10 to 80 cm. high; petals yellow *P. fruticosa*
2. Stems usually plainly herbaceous, at most slightly woody at base, *3*
3. Leaves pinnate, the leaflets 7 to 11; flowers yellowish, 10 to 15 mm. across *P. arguta*
3. Leaves palmate, *4*
4. Flowers solitary from naked peduncles from the axils of the foliage leaves or on the stolons, *5*
5. First flower from the node above the first well-developed internode *P. canadensis*
5. First flower from the node above the second or third well-developed internode ***P. simplex***

4. Flowers cymose in terminal inflorescences, *6*
6. Leaves silvery-tomentose beneath *P. argentea*
6. Leaves green beneath, pubescent or smoothish, *7*
7. Petals white; leaflets wedge-oblong, coarsely 3-toothed at apex; plants low, tufted, smooth or essentially so, rather woody at base *P. tridentata*
7. Petals yellow; plants coarse, hirsute, erect, 20 to 90 cm. high, *8*
8. Leaflets 3; petals about equaling the calyx lobes *P. norvegica*
8. Leaflets 5 to 7; petals much exceeding the calyx lobes *P. recta*

P. palustris (L.) Scop. Purple cinquefoil. Known only from the swampy borders of Knickerbocker Lake, where very abundant, *1194.*

P. fruticosa L. Shrubby cinquefoil. Swamps and moist open hillsides; frequent eastward, where very abundant in the calcareous regions of the Harlem Valley and of Canaan and New Lebanon; rare in the Hudson Valley and adjacent uplands. Bog west of Post Road School, Kinderhook; Mount Lebanon; Canaan; Miller Pond, Ancram; Boston Corners; pond south of Taghkanic Lake; Copake Falls.

P. arguta Pursh. Dry fields and rocky banks of streams; infrequent, but appearing widely distributed; usually semi-weedy. Valatie, *3755;* Stuyvesant Falls, *938;* Mount Merino, *2307;* [Brace Mountain, *House 24842*]. Seen also at North Chatham and at Copake Lake.

P. canadensis L. Dwarf cinquefoil. Fields and woods, in dry or sandy soil; frequent.

P. simplex Michx. Common cinquefoil. With the last; common and somewhat weedy.

P. argentea L. Silvery cinquefoil. Fields and pastures, in dry sandy or rocky soil; frequent.

P. tridentata Ait. Bare rocky summits above 450 meters elevation, on schistose or quartzitic rocks, in the towns of Copake and Ancram, extending eastward and southeastward into Massachusetts and Connecticut; very abundant on all the peaks in this limited area. Mount Fray, *2635;* Mount Alander, *1765;* 1 mile northeast of Boston Corners, *2266;* [Brace Mountain, *House 24807*]; summit of Stissing Mountain, according to Hoysradt (1874b), and Peck (28th Report N. Y. State Mus. 83. 1879).

P. norvegica L. Rough cinquefoil. Dry fields, often in cultivated and waste land, or in woods; common. Represented in our area only by var. **hirsuta** (Michx.) Lehm.

P. recta L. Fields and roadsides; occasional. Locally very abundant, as in the vicinity of West Copake, *1070.* Brainard, *House 21363;* becoming increasingly abundant in meadows in the Hudson Valley.

5. Fragaria L.

1. Lower surface of the leaflets, between the veins, glabrous or practically so; leaflets dull glaucous green above; achenes immersed in pits in the flesh of the receptacle *F. virginiana*
1. Lower surface of the leaflets silky between the veins; leaflets bright green above; achenes not immersed in pits in the flesh of the receptacle, *2*
2. Petioles and peduncles more or less villous with spreading hairs *F. vesca*
2. Petioles and peduncles mostly sparsely pubescent with somewhat appressed hairs *F. vesca* var. *americana*

F. virginiana Duchesne. Wild or field strawberry. Fields and woods; in rich soil; common.

F. vesca L. Occasional; perhaps always an escape.

F. vesca var. **americana** Porter. Wood strawberry. Shaded banks and moist cool woods; frequent, especially eastward, but nowhere abundant. Mount Merino, *House 22642*; New Forge, *3473*; east of Cannan, *4261*; [Millerton, *House 22408*].

6. **Agrimonia** L.

1. Rachis of inflorescence covered with minute glandular pubescence interspersed with long, widely spreading hairs; mature fruit 5 to 6 mm. in diameter, the longer bristles 3.5 to 4 mm. long *A. gryposepala*

1. Rachis closely pubescent, without long spreading hairs; bristles of the fruit not over 2.5 mm. long, *2*

2. Leaflets, exclusive of the little intermediate ones, usually 5 to 9, ovate to obovate or elliptic-oblong; hypanthium 3 to 5 mm. long, *3*

3. Leaves plainly glandular-atomiferous beneath, downy principally on the veins *A. striata*

3. Leaves obscurely or not at all atomiferous beneath, the lower surface velvety-tomentose *A. pubescens*

2. Leaflets, exclusive of the little intermediate ones, 11 to 13, narrow, lanceolate to narrowly lance-oblong; hypanthium about 2 mm. long *A. parviflora*

A. gryposepala Wallr. Pastures, roadsides and wooded banks; common.

A. striata Michx. Woods and thickets; apparently not frequent. Stephentown Center, *House 21682;* North Chatham, *Peck;* 3 miles east of Stuyvesant, *1549.*

A. pubescens Wallr. Infrequent or poorly known; Waldorf Pond, *House 20907;* Kinderhook Lake, *House 18861;* 1 mile southeast of West Ghent, in alluvial soil, *3696.*

A. parviflora Ait. Pastures and thickets; infrequent, but locally very abundant. Two miles north of Chatham, *4515;* 1 mile north of Linlithgo, *3964;* Pine Plains, *Peck.*

7. **Waldsteinia** Willd.

W. fragarioides (Michx.) Tratt. Barren strawberry. Rocky or rich woods; frequent, but local. Curtis Mountain, *House 21471;* Riders Mills, *1259;* 2 miles west of Red Rock, *4155* (GA); Spencertown, *4130;* junction of Punsit Creek and Indian Brook, northwest corner of Austerlitz, *4115* (GH); 3 miles north of Claverack, on limestone, *561;* 2 miles south of Claverack, in clay soil, *3994;* 3 miles southeast of Harlemville, *1136;* near Baker Mills, Germantown, *3249.*

8. **Geum** L. Avens

1. Upper joint of style hairy, deciduous; calyx green; petals white or yellow, *2*

2. Petals white or pale greenish yellow, as long as the calyx or shorter; stipules mostly 1 to 1.5 cm. long, *3*

3. Receptacle of the fruit glabrous or nearly so; plants bristly-hairy; peduncles stout, hirsute with reflexed hairs *G. laciniatum*

3. Receptacle of fruit densely bristly; plants slender, soft-hairy; peduncles very slender, not hirsute *G. canadense*

2. Petals golden yellow, conspicuous, exceeding the calyx; stipules mostly 1.5 to 4 cm. long *G. aleppicum*

1. Upper joint of the style plumose; calyx purple; petals purplish cream color *G. rivale*

G. laciniatum Murr. Woods and swampy places; common.

G. canadense Jacq. Woods and thickets; common.

G. aleppicum Jacq. Yellow avens. Wet meadows, thickets and swampy woods; frequent. Copake Falls, *Britton et al.* (NY); Kinderhook, *1224, 1419;* Chatham Center, *1398* (PENN); 2 miles south of Germantown, *3159;* [Claverack, *Rev. A. P. Van Gieson* (V)]. In our area represented only by var. **strictum** (Ait.) Fern.

G. rivale L. Purple avens. Wet meadows, open marshes and moist thickets; frequent eastward, where abundant in calcareous regions; rare in the Hudson Valley. West of Post Road School, Kinderhook, *721;* Brainard, *House 21367;* Canaan, *744;* Chatham, *Iva Allen;* 2 miles southeast of Martindale, *584;* 1.5 miles south of Ancramdale, *3383.*

9. Dalibarda Kalm

D. repens L. Cool moist woods; rare in our area. Taplins' Pond, *2420*; 1 mile west of East Nassau, *4741* (USNA).

10. Rubus L.

1. Leaves simple, 3- to 5-lobed; stems not armed with prickles; flowers purple *R. odoratus*

1. Leaves compound, with 3 to 7 leaflets; petals white, *2*

2. Leaves white-tomentose beneath; fruit hollow, separating easily from the receptacle, *3*

3. Fruit purplish black; canes recurved, purple, strongly glaucous *R. occidentalis*

3. Fruit red; canes erect, bronzy, not strongly glaucous *R. idaeus*

2. Leaves green beneath, not white-tomentose; fruit not separating from the receptacle, *4*

4. Plants unarmed, low, erect or nearly so, 10 to 40 cm. high, the stems herbaceous or soft woody at base; fruit red, not separating easily from the receptacle *R. pubescens*

4. Plants woody, usually prickly, erect or creeping; fruit usually black, *5*

5. Canes erect or arched-ascending, *6*

6. Pedicels usually not thorny, rarely with a few weak bristles, *7*

7. Pedicels copiously glandular-hispid *R. allegheniensis*

7. Pedicels glandless or with occasional gland-tipped hairs, *8*

8. Lower surface of leaflets, even at maturity, downy to the touch *R. frondosus*

8. Leaves nearly or quite glabrous beneath, except on the veins *R. canadensis*

6. Pedicels prickly; canes armed with uniform and very numerous setae *R. Groutianus*

5. Canes trailing or at least tending to be prostrate toward the ends, *9*

9. Fruit reddish purple, of a few sour drupelets; leaves sub-evergreen, firm and often glossy; body of sepals about 3 mm. long *R. hispidus*

9. Fruit black, large, sweet when ripe; leaves thin; body of sepals 5 mm. long or more *R. flagellaris*

R. odoratus L. Purple-flowering raspberry. Woods and thickets; common. Most abundant eastward, where often very conspicuous along roadsides in woods.

R. pubescens Raf. Swamps and wet woods, often on sphagnous hummocks; also in calcareous situations; common eastward, but local and less abundant in the Hudson Valley. Niverville, *413* (PENN); Greendale, *4327;* Rogers Island, *2585.*

R. idaeus L. Wild red raspberry. Woods, pastures and clearings, in dry or rocky soil; common. Represented in our area by var. **strigosus** (Michx.) Maxim.

R. occidentalis L. Wild black raspberry. With the preceding; common. This species, and the preceding one, form thickets in recently cleared land and so act as weed species, often excluding other woody plants for some years.

R. allegheniensis Porter. Highbush blackberry. Fields, thickets, clearings and borders of woods; common, and somewhat weedy.

R. frondosus Bigel. This species has not been reported from within the limits of Columbia County, but it is known to occur in both Dutchess and Rensselaer Counties, and doubtless occurs in our area.

R. canadensis L. Thornless or mountain blackberry. This species is well known from Sand Lake and Berlin. It has been observed north of Stephentown Center (House), and is increasingly common northward. It is probably more common in the northern part of our area than the collections indicate.

R. flagellaris Willd. Dewberry. Dry sandy or rocky soil, in open fields or in thickets; common.

R. Groutianus Blanch. Frequent farther north in the State; in our area known only from a swamp at Knickerbocker Lake, *House 23703* [specimen determined by L. H. Bailey].

R. hispidus L. Running swamp blackberry. Swamps and moist woods, often on sphagnous hummocks; throughout. Common, but most abundant eastward, and rather local in the Hudson Valley. [A specimen from near No Bottom Pond, *4522,* differs from *R. hispidus* in having small prickles interspersed with the bristles of the primocane, and has been identified by Mr. S. J. Smith as *Rubus permixtus* Blanch.]

11. **Rosa** L. Rose

1. Stems with large coarse hooked spines often 1 cm. long; leaflets densely glandular-resinous beneath, 2 cm. long or less *R. Eglanteria*

1. Stems spineless or with small or needlelike prickles or spines; leaves somewhat pubescent or glabrous beneath, *2*

  2. Calyx lobes after flowering usually deciduous; inflorescence usually glandular, *3*

    3. Shrubs of bogs and moist shores, often armed with flattened prickles; number of teeth on each side of a normal leaflet about 26 *R. palustris*

    3. Shrubs of rocky shores, dry uplands and plains; prickles, if present, usually terete; number of teeth on each side of leaflet about 12 *R. carolina*

  2. Calyx lobes persistent after flowering, erect and persistent on the fruit; inflorescence not glandular; stems glabrous, unarmed or bristly at base only; teeth of leaflets about 12 on each side *R. blanda*

R. Eglanteria L. Sweetbrier. Old fields and pastures, as an escape; frequent on the clay soils of the Hudson Valley; occasional elsewhere. Poelsburg, *3184;* Mount Merino, *1102.*

R. palustris Marsh. Swamp rose. Open swampy thickets and wet grounds; common. Very abundant in the calcareous marshes of the Harlem Valley.

R. carolina L. Pasture rose. Woods, pastures and fence rows, in dry or rocky soil; frequent. Brainard, *House 21522;* Kinderhook Lake, *House 11314;* Rhinecliff, *House 19261;* 2 miles southwest of Hillsdale, *3552.*

R. blanda Ait. Smooth rose. Thickets in wet places about lakes and ponds; Shaver Pond, Copake, *839;* Kinderhook Lake, *904.* Doubtless elsewhere.

12. **Sorbus** L.

1. Leaflets lanceolate, acuminate, glabrous *S. americana*
1. Leaflets narrowly oblong, mostly obtuse at tip, pubescent or tomentose at least beneath *S. Aucuparia*

S. americana *Marsh.* (*Pyrus americana* of *Gray's Manual*). "Mountain ash." Rocky summits in the eastern towns, at elevations greater than 300 meters; frequent but local. Otherwise known only from swampy woods bordering a sphagnum bog southeast of Knickerbocker Lake, *1010.*

S. Aucuparia L. *(Pyrus Aucuparia* of *Gray's Manual).* Rowan tree. Occasionally spontaneous in woods and along fences; Old Chatham, *632;* 1 mile southwest of West Ghent, *3299.*

13. **Aronia** Medic.

1. Inflorescence and lower surface of leaves tomentose; fruit bright red *A. arbutifolia*
1. Inflorescence and leaves glabrous almost from the first; fruit black *A. melanocarpa*

A. arbutifolia (L.) Pers. *(Pyrus arbutifolia* of *Gray's Manual).* Red chokeberry. Bogs in the southeastern part of our area; rare. Miller Pond, Ancram, *3122;* 3 miles north of Ancramdale, *3898;* swamp south of Mount Riga Station, *3364.* A collection from Stephentown Center, *House 21679,* with immature fruit, is apparently of this species.

A. melanocarpa (Michx.) Ell. *(Pyrus melanocarpa* of *Gray's Manual).* Black chokeberry. Swamps and rocky uplands, preferring acid soil; common except in the Hudson Valley, where infrequent. North Chatham, *1037;* Niverville, *572;* West Ghent, *1117;* Fowlers' Lake, *716.*

14. **Malus** Mill. Apple

M. pumila Mill. (*Pyrus Malus* of *Gray's Manual*). Common in cultivation and often escaping to fence rows and old fields.

15. **Amelanchier** Medic. Shadbush

1. Inflorescence a raceme, mostly 5- to 12-flowered; leaves folded when young, *2*
  2. Teeth of the leaves coarse, on mature leaves mostly 3 to 5 per cm.; hypanthium prominent and cup-shaped on the young fruit; plants shrubby, not treelike, *3*
    3. Petals 11 to 22 mm. long; leaves oval, with prominent teeth and straight veins, *4*
      4. Petals 11 to 15 mm. long; lower pedicels 7 to 20 mm. long; sepals 2 to 3 mm. long; plant somewhat stoloniferous, usually in large clumplike colonies *A. sanguinea*
      4. Petals 16 to 22 mm. long; lower pedicels 27 to 40 mm. long; sepals 3 to 5 mm. long; plants scarcely stoloniferous, with few stems *A. amabilis*
    3. Petals 7 to 10 mm. long; leaves oblong, with somewhat irregular veins; plants 1.5 meters high or less, stoloniferous *A. humilis*
  2. Teeth of the leaves fine, on mature leaves mostly 5 to 12 per cm., *5*
    5. Leaves densely white-tomentose when young, becoming green, *6*
      6. Leaves rounded or blunt at apex; summit of ovary woolly; low stoloniferous shrub 1.5 meters high or less *A. stolonifera*
      6. Leaves acute or acuminate; summit of ovary glabrous or nearly so; tall shrubs or trees, *7*

7. Leaves oblong or oblong-obovate, acute; petals 6 to 8 mm. long; tall shrubs with an alderlike habit *A. canadensis*
7. Leaves ovate or obovate, acuminate; petals 10 to 18 mm. long; plant a small or large tree, not in clumps *A. arborea*
5. Leaves and inflorescence glabrous from the first, the foliage usually reddish when young; petals 10 to 18 mm. long *A. laevis*
1. Flowers solitary or mostly in pairs or 3's; leaves flat even when very young *A. Bartramiana*

A. arborea (Michx. f.) Fern. Woods and fence rows, in dry sandy or rocky soil; common. Our most abundant species of shadbush.

A. laevis Wieg. Rocky woods, in dry soil on schist and quartzite; frequent eastward, at elevations of more than 300 meters; unknown in the Hudson Valley. Easily distinguished when in flower by the smooth leaves, which are often suffused with red. Douglas Knob, New Lebanon, *3625*; No Bottom Pond, *459;* Spencertown, *4201;* 2 miles southeast of Churchtown, *4186;* Washburn Mountain, *4218;* [Perry Peak, Canaan, *House 21190*].

A. canadensis (L.) Medic. Calcareous marshes; plants apparently of this species were collected 3 miles north of Ancramdale, *3891*.

A. stolonifera Wieg. Exposed rocky summits above 450 meters elevation, in the towns of Copake and Ancram, extending eastward and southeastward into Massachusetts and Connecticut; rather abundant on the peaks in this limited area, forming dense patches. Mount Fray, *2642;* Washburn Mountain, *3457*. According to Jones (1946), this species and *A. humilis* are to be referred to *A. spicata* (Lam.) K. Koch.

A. humilis Wieg. Dry shaly hillsides and bluffs, in the Hudson Valley; in this area rather frequent, but never abundant. Poelsburg, *3186;* Nutten Hook, *444;* Columbiaville, *3706;* Blue Hill, *615*.

A. amabilis Wieg. Shale and limestone ledges; infrequent. Stuyvesant Falls, on shale bluffs, *437;* Old Chatham, on limestone, *633*. Not distinct from *A. sanguinea,* according to the most recent monograph on this genus (Jones, 1946).

A. sanguinea (Pursh) DC. Rocky woods, in sterile or acid soil. In our area known only from Douglas Knob, New Lebanon, *3626*.

A. Bartramiana (Tausch) Roem. Collected in 1943 southeast of Taborton, in the game refuge near the line between the towns of Berlin and Stephentown, *House 29350*. See note on geographical distribution under *Hierochloë odorata*. This species is usually easily distinguished from other species of *Amelanchier* by having the flowers in pairs or 3's, instead of in racemes.

16. **Crataegus** L. Hawthorn, Thornapple

1. Leaves deeply pinnately lobed *C. monogyna*
1. Leaves not deeply pinnately lobed, the blades serrate and incised or shallowly lobed, *2*
2. Leaves conspicuously cuneate at base, the blades widest near the tip or toward the middle, *3*
3. Stamens 7 to 10, *4*
4. Leaves simply serrate, elliptic to obovate, not lobed, coriaceous, dark green and shining above; spines often long and recurved *C. Crus-galli*
4. Leaves broader, rhombic-ovate to suborbicular, usually doubly serrate and often incised-lobed, not coriaceous, *5*
5. Leaves usually with impressed veins; sepals glandular-serrate *C. macracantha*
5. Leaves not impressed-veined; sepals entire, with glandular margins *C. chrysocarpa*

3. Stamens 17 to 22; leaves glabrous above, stiff-velvety beneath; twigs glabrous, reddish, polished; sepals broad, strongly serrate *C. succulenta*

2. Leaves subcordate, truncate, rounded or rarely somewhat wedge-shaped at base; stamens 5 to 12, *6*

6. Foliage, corymbs and ovaries rough-hairy and glandular; sepals serrate; winter buds not sticky *C. intricata*

6. Leaves slightly hairy, becoming glabrate; inflreorescence usually glabrous; sepals narrow, entire, reflexed; winter buds sticky, especially when unfolding *C. macrosperma*

C. monogyna Jacq. European hawthorn. Fields, pastures and woods; occasional, as an escape from cultivation. Easily recognized by the finely cut leaves.

C. Crus-galli L. Cockspur thorn. Sandy or shaly soil in fields and woods; infrequent. Mount Merino, *2436*.

C. intricata Lange. Rocky woods; well known in the Hudson Valley (see House, 1924), but elsewhere in our area seen only from a limestone hill 3 miles north of Ancramdale, *797*.

C. chrysocarpa Ashe. A specimen collected by *A. T. Beals,* probably at Chatham, is of this species, according to a determination made by the late W. W. Eggleston (NY).

C. macrosperma Ashe. Hillsides, fields and thickets, in dry or moist soil; common, and very variable. Kinderhook Lake, *House 13406* (var. *matura,* according to Eggleston); Chatham, *A. T. Beals* (NY; determined by Eggleston); Kinderhook, *494;* Old Chatham, *642;* 2 miles east of Austerlitz, *700;* Copake Lake, *Muenscher & Clausen 4659* (CU; determined by Muenscher).

C. succulenta Link. Known only from Mount Lebanon, *House 16236.*

C. macracantha *Lodd.* (*C. succulenta,* var. *macracantha* of *Gray's Manual*). Known only from the edge of a swampy thicket, Shaver Pond, Copake, *840.* Perhaps not specifically distinct from the preceding species.

17. **Prunus** L.

1. Flowers in elongated racemes, *2*

2. Calyx persistent on the fruit; large tree with purplish black fruit; leaves crenate-serrate with incurved teeth *P. serotina*

2. Calyx early deciduous; tall shrub or small tree with dull red fruit; leaves sharply serrate with fine, somewhat spreading teeth *P. virginiana*

1. Flowers in umbels or subcorymbose clusters, *3*

3. Plant a dwarf shrub mostly less than 1 meter high; leaves narrow, spatulate-oblong, pale beneath *P. pumila*

3. Plants arborescent, *4*

4. Fruits 7 to 8 mm. in diameter; flowers 1.5 cm. across or less; leaves very finely and irregularly crenate-dentate *P. pensylvanica*

4. Fruits 15 to 20 mm. in diameter, or larger; flowers 2 to 3 cm. in diameter, *5*

5. Leaves convolute in bud; stone flattened; winter twigs usually without a terminal bud *P. domestica*

5. Leaves folded in bud; stone globose; winter twigs with a terminal bud, *6*

6. Leaves firm, waxy, glabrous or nearly so from the first; veins 6 to 8 pairs; fruit sour *P. Cerasus*

6. Leaves thin, hairy when young; veins 10 to 14 pairs; fruit sweet *P. Avium*

P. domestica L. Garden plum. Established in yards and along fences as an escape; occasional.

P. pumila L. (Including *P. susquehanae* of *Gray's Manual*). Dwarf cherry. Bare rocky summits; frequent in the southeastern part of our area. Known also from a shaly bluff above the Hudson River at the Columbia-Rensselaer County line, *579*. 2 miles southeast of Churchtown, *3516;* Washburn Mountain, *3456;* Cedar Mountain, *3575;* Stissing Mountain, *3879*. The report of *P. pygmaea* from Green Island, Troy, by Wright and Hall (1836), perhaps is based upon this species, as are reports of *P. depressa* Pursh.

P. Cerasus L., and **P. Avium** L., the cultivated cherries, are occasionally found as escapes from cultivation.

P. pensylvanica L.f. Bird cherry, fire cherry. Dry rocky woods, shaly bluffs and open sandy fields; common. Most abundant eastward, and on recently cleared or burned land. Rather local in the Hudson Valley; Niverville, *439*.

P. virginiana L. Choke cherry. Thickets and fence rows; common.

P. serotina Ehrh. Wild black cherry. Woods; common.

LEGUMINOSAE (Pea Family)

1. Corolla nearly regular, the petals free from each other or essentially so; stamens distinct, *2*
  2. Flowers greenish white; large trees with numerous long spines 2. **Gleditsia**
  2. Flowers yellow, showy; plants herbaceous 1. **Cassia**
1. Corolla papilionaceous; upper petal larger than the others and inclosing them in the bud; two lower petals more or less coherent by their edges and forming a keel, *3*
  3. Stamens 10, distinct 3. **Baptisia**
  3. Stamens united by their filaments, *4*
    4. Stamens united in one group (monadelphous); anthers of two different shapes, the two sorts alternating, *5*
      5. Leaves simple; flowers yellow 4. **Crotalaria**
      5. Leaves palmately compound; flowers blue or white 5. **Lupinus**
    4. Stamens united in two groups (diadelphous), the filament opposite the large petal free from the rest; anthers alike, *6*
      6. Leaves 3-foliolate (sometimes appearing pinnate because of the two large stipules), *7*
        7. Leaflets serrulate; pods 1- to 6-seeded, very small, *8*
          8. Pods curved or coiled 6. **Medicago**
          8. Pods straight or essentially so, *9*
            9. Flowers in dense heads 8. **Trifolium**
            9. Flowers in elongated racemes 7. **Melilotus**
        7. Leaflets entire (rarely lobed, but not serrulate), *10*
          10. Plants climbing or twining; pods dehiscent, not jointed, *11*
            11. Style beardless; keel of corolla almost straight 17. **Amphicarpa**
            11. Style bearded lengthwise on the upper surface; keel long, strongly incurved 18. **Strophostyles**
          10. Plants neither climbing nor twining (sometimes prostrate), *12*
            12. Flowers yellow; pods dehiscent, not jointed; stipules as large as the leaflets 9. **Lotus**
            12. Flowers whitish to purplish; pods of one to several 1-seeded joints, indehiscent, *13*
              13. Leaflets not stipellate; pod 1-seeded, 1- to 2-jointed 13. **Lespedeza**
              13. Leaflets stipellate; pod 2- to several-seeded, several-jointed 12. **Desmodium**

6. Leaves pinnate, *14*
  14. Herbs with pinnate leaves terminated by tendrils, *15*
    15. Wings (lateral petals) and keel coherent; style filiform, bearded at apex only — 14. **Vicia**
    15. Wings nearly free from the keel; style flattened, bearded down the inner face — 15. **Lathyrus**
  14. Leaves odd-pinnate, tendrils wanting, *16*
    16. Plants woody, shrubby or arborescent — 10. **Robinia**
    16. Plants herbaceous, *17*
      17. Plants twining, vinelike; flowers brownish purple, very fragrant — 16. **Apios**
      17. Plants erect, with umbellate rose-colored flowers — 11. **Coronilla**

1. **Cassia** L.

1. Plant annual, 14 to 40 cm. high; flowers 4 to 8 mm. broad; pods 2.5 to 4 cm. long — *C. nictitans*
1. Plant perennial with a woody base, 90 to 120 cm. high; flowers 15 to 20 mm. broad; pods 6.5 to 11 cm. long — *C. hebecarpa*

C. nictitans L. Wild sensitive plant. Dry shaly hillsides in the Hudson Valley; rare. Two miles north of Tivoli, *2979;* 1 mile south of Germantown, *3961.*

C. hebecarpa Fern. Wild senna. Swamps and wet land along the Hudson River near tidewater; frequent. Three miles north of Castleton, *3966;* Stuyvesant, *House;* Stockport Station, *1510;* also abundant on Rogers Island, and near Poelsburg.

2. **Gleditsia** L.

G. triacanthos L. Honey locust. Cultivated, and occasionally spontaneous in woods and fields.

3. **Baptisia** Vent.

B. tinctoria (L.) R. Br. Wild indigo. Dry woods and fields; common. Represented in our area only by var. **crebra** Fern.

4. **Crotalaria** L.

C. sagittalis L. Rattlebox. Sandy or waste ground, weedy; rare. Railroad bank at Spring Lake, *2746;* sandy hillside southwest of Kinderhook, *4024.*

5. **Lupinus** L.

L. perennis L. Wild lupine. Dry sandy or shaly soil; rare. Known from a single station, a shaly hillside in the extreme southwestern corner of the town of Hillsdale, *581.* Reported from Copake Falls by Stetson (1914) and from Kinderhook by Woodworth (1839).

6. Medicago L.

1. Petals blue to purple; pods twisted, pubescent; plants more or less erect, usually 30 to 60 cm. tall — *M. sativa*
1. Petals yellow; pods nearly glabrous, kidney-shaped; plants decumbent, the stems spreading along the ground for 30 to 60 cm. — *M. lupulina*

M. sativa L. Alfalfa. Common in cultivation and often escaped to roadsides and fence rows.

M. lupulina L. Hop clover. Cultivated and waste ground; locally established as a weed.

7. Melilotus Mill.

1. Petals white; legume (pod) netted on the surface or almost smooth *M. alba*
1. Petals yellow; legume with strong transverse ridges, scarcely at all netted *M. officinalis*

M. alba Desr. White sweet clover. Roadsides and waste ground; weedy, common.

M. officinalis (L.) Lam. Yellow sweet clover. With the preceding; common. Both species of *Melilotus* have increased greatly in abundance in recent years, especially along road cuts and fills.

8. Trifolium L.

1. Corolla yellow, conspicuously striate in age; leaflets all sessile *T. agrarium*
1. Corolla white, pink or purplish, *2*
  2. Flowers sessile or nearly so, in dense heads, *3*
    3. Calyx teeth silky-feathery, surpassing the corolla; heads becoming very soft-silky and grayish *T. arvense*
    3. Calyx teeth hairy or nearly smooth, shorter than the corolla; heads pinkish purple, not silky *T. pratense*
  2. Flowers evidently pedicelled, in rather loose heads, *4*
    4. Corolla white; stems creeping, rooting at the nodes, the peduncles arising from the ground *T. repens*
    4. Corolla usually pink or purplish pink; stems ascending, not rooting at the nodes *T. hybridum*

T. agrarium L. Yellow clover. Fields and roadsides; frequent.

T. arvense L. Rabbit-foot clover. Dry fields and waste places; common.

T. pratense L. Red clover. Fields and meadows; often cultivated and frequently well established.

T. repens L. White clover. Lawns and cultivated or waste ground; common.

T. hybridum L. Alsike clover. Fields, meadows and cultivated grounds; often cultivated and frequently becoming established and weedy.

9. Lotus L.

L. corniculatus L. Bird's-foot trefoil. Clays and shaly soils in the Hudson Valley and very recently in the Harlem Valley; common. Often very abundant in pastures and along roadsides, forming dense stands. Poelsburg, *897;* 2 miles west of Kinderhook, *206* (PENN); Nutten Hook, *Muenscher & Clausen 4670* (CU); 3 miles north of Claverack, *1309;* 2 miles south of Germantown, *3157;* [roadside south of Hillsdale, *House 23674*]. A recent adventive which is now spreading extensively and may prove to be of considerable value as a forage plant.

10. Robinia L.

1. Branches and petioles glabrous or essentially so; racemes slender, loose; flowers white, fragrant *R. Pseudo-Acacia*
1. Branches and petioles sticky; racemes densely crowded; flowers rose-colored, nearly inodorous *R. viscosa*

R. Pseudo-Acacia L. Black locust. Woods and thickets; not native in eastern New York, but well established throughout our area and locally very abundant.

R. viscosa Vent. Clammy locust. Roadsides and old dooryards; occasionally established as an escape; Stuyvesant, *931;* West Taghkanic, *1091.*

11. Coronilla L.

C. varia L. Roadsides; infrequent, occurring locally in patches. Kinderhook, *Wibbe;* north of Jackson Corners, *3203;* seen also about 1 mile north of North Chatham.

12. Desmodium Desv. Tick trefoil

1. Peduncles very long and leafless; pod on a long stalk within the calyx; leaves all crowded at summit of stem; joints of the pod straight or concave on the back, *2*
  2. Leaves and flowers on separate stems, the raceme on an ascending naked branch from near the base of the plant *D. nudiflorum*
  2. Elongated naked raceme at the summit of the leafy stem *D. glutinosum*
1. Peduncles not conspicuously elongated; stalk of pod never more than twice the length of the calyx; joints of the pod more or less convex on the back, *3*
  3. Plants trailing, prostrate, soft-hairy all over; leaflets orbicular; racemes simple, axillary and terminal *D. rotundifolium*
  3. Plants more or less erect, glabrous or hairy; racemes panicled; leaflets somewhat elongated, not orbicular, *4*
    4. Stipules and bracts large and conspicuous, 1 to 1.5 cm. long; plant very smooth except the panicle; leaflets green and glabrous on both sides, lance-ovate and taper-pointed . *D. cuspidatum*
    4. Stipules smaller, inconspicuous; joints of the pod about as broad as long, *5*
      5. Pod on a stalk equaling or slightly exceeding the surrounding calyx, *6*
        6. Plant essentially smooth throughout *D. paniculatum*
        6. Leaflets pubescent, especially beneath; stem granular-roughened and often hairy *D. perplexum*
      5. Pod sessile in the calyx, or essentially so *D. canadense*

D. nudiflorum (L.) DC. Dry or moist woodlands, in clay or sandy soils; common, throughout. The fruits of this and the other species of *Desmodium* are known as "Beggar lice" because of their property of adhering tightly to clothing.

D. glutinosum (Muhl.) Wood. With the preceding species; common throughout, and locally very abundant.

D. rotundifolium DC. Dry rocky woods, in the southern part of our area; infrequent. One mile east of Pulvers, Ghent, *2350;* Robinson Pond, *3941;* Risedorph Hill, Pine Plains, *House 21040.* Hoysradt (1875-79) reports the species as "common in rocky woods," at Pine Plains.

D. cuspidatum (Muhl.) Loud. Dry soil, in woods; infrequent or rare. Two miles east of Chatham Center, *3677;* Robinson Pond, *3946.* Perhaps increasing in abundance southward; reported by Burnham (1913) from Copake Falls, and by Hoysradt (1875-79) as "rather common" at Pine Plains.

D. paniculatum (L.) DC. Dry open places, woods and thickets; throughout, but never very abundant. Kinderhook, *1789;* Green River, *1514;* Robinson Pond, *3938;* [southwest of Mount Alander, *House 24789*].

D. perplexum Schub. Dry rocky woods; rare. Reported several times from our area, but most reports seem to be based upon *D. canadense.* Plants from 1 mile east of Pulvers, Ghent, *2349,* are apparently of this species.

D. canadense (L.) DC. Thickets and open banks, often along streams, extending occasionally to roadsides; common along the Hudson River and its larger tributaries, and less so eastward. Niverville; Stuyvesant; Malden Bridge; Chatham Center; Nutten Hook; Boston Corners; Pine Plains.

13. Lespedeza Michx.

1. Calyx 2 to 5 mm. long, shorter than the pod and much exceeded by the corolla; flowers of two kinds, some bearing petals and others lacking them, *2*
- *2.* Stems downy-pubescent, prostrate and trailing — *L. procumbens*
- *2.* Stems erect or spreading, smooth or pubescent, *3*
  - *3.* Peduncles elongated, filiform, much longer than the leaves; flowers few, 8 to 10 mm. long — *L. violacea*
  - *3.* Peduncles stouter, scarcely filiform, some or all of them shorter than the leaves; flowers 5 to 7 mm. long, *4*
    - *4.* Stems villous; most of the peduncles exceeding the leaves; pods strongly pubescent, mostly 5 to 6 mm. long — *L. Nuttallii*
    - *4.* Stems slightly appressed-pubescent or glabrate; peduncles mostly very short, crowded, a few nearly equaling the leaves; pods slightly pubescent or glabrate, mostly about 4 mm. long, *5*
      - *5.* Leaflets oval or oblong; petaliferous inflorescences often short-peduncled — *L. intermedia*
      - *5.* Leaflets linear to linear-oblong; petaliferous inflorescences crowded, mostly sessile or nearly so — *L. virginica*

1. Calyx 5 to 7 mm. long, exceeding the pod and scarcely shorter than the corolla; flowers all alike, petaliferous and perfect, in close spikes or heads, *6*
- *6.* Peduncles mostly shorter than the dense subglobose heads — *L. capitata*
- *6.* Peduncles elongate, mostly equaling the thick cylindric spikes — *L. hirta*

L. procumbens Michx. Dry shaly hillsides; rare. In our area known only from Blue Hill, *2167*. "Common on hills" at Pine Plains, according to Hoysradt; becoming much more frequent southward in the State.

L. violacea (L.) Pers. Dry shaly hillsides in the Hudson Valley and locally in the Harlem Valley; infrequent. Alvords' Dock, Stockport, *2223;* 2 miles east of Germantown, *2921;* Robinson Pond, *3943*.

L. Nuttallii Darl. Dry rocky woods; rare. A collection from east of Pulvers, Ghent, *2345,* resembles a large specimen of *L. intermedia,* but has the elongated peduncles of *L. Nuttallii.*

L. intermedia (S. Wats.) Britt. Dry soil, in sandy or rocky places in woods or fields; common, perhaps throughout. Abundant in the Hudson Valley and adjacent uplands, on the shales; not reported from the higher elevations eastward. Curtis Mountain; Poelsburg; Pulvers, Ghent; Churchtown; Blue Hill; Tivoli; Pine Plains.

L. virginica (L.) Britt. Dry sandy or shaly hillsides; rare. Known only from a hill about 4 miles north of Kinderhook, in sand, *2360,* and from Blue Hill, in shaly soil, *2181*.

L. hirta (L.) Hornem. Dry sandy or rocky hills and woodlands; rare. Copake Falls, *Britton et al.* (NY); Stissing Mountain, *House 21019;* [North Chatham, *House 20915*].

L. capitata Michx. Dry soil, in sandy and shaly fields and hillsides; common in the Hudson Valley, but not reported eastward. Kinderhook Lake, *House 15977;* Kinderhook, *2250;* Blue Hill, *2188*.

14. Vicia L. Vetch

1. Flowers small, 2 to 4 mm. long, bluish; seeds 4 — *V. tetrasperma*
1. Flowers 6 to 18 mm. long, purple-blue; seeds 6 or more — *V. villosa*

V. tetrasperma (L.) Moench. Meadows and fields; occasional as a weed, usually in patches.

Figure 19. The hog peanut, *Amphicarpa bracteata* var. *comosa,* in a swamp just north of Kinderhook

V. villosa Roth. Fields and roadsides, as an escape; infrequent and usually not long persistent.

15. Lathyrus L.

L. palustris L. Wild pea. Tidal swamps of the Hudson River; frequent, but never very abundant. Rogers Island, *2583;* Crugers' Island, *3246.* Reported by Hoysradt (1875-79) from "Hot Ground" (Ancramdale). In our area represented only by var. **myrtifolius** (Muhl.) Gray.

16. Apios Medic.

A. americana Medic. Wild bean. Swamps and margins of streams and ponds; frequent. Deserving of cultivation for its dark green foliage and its sweet-scented and oddly colored flowers.

17. Amphicarpa Ell.

1. Plants appressed-pubescent or glabrate; terminal leaflet 4 to 6 cm. long *A. bracteata*

1. Plant villous-pubescent, the pubescence spreading, often tawny; terminal leaflet 5 to 8 cm. long *A. bracteata* var. *comosa*

A. bracteata (L.) Fern. Hog peanut. Woods; common. Most abundant in rich or swampy soils.

A. bracteata var. **comosa** (L.) Fern. Swamps and alluvial grounds; frequent in the Hudson Valley; unknown elsewhere. Castleton, *House 18868;* Stuyvesant, *House 13305;* Kinderhook, *1983;* Nutten Hook, *2220* (PENN); Madalin, *2879.* (figure 19.)

18. Strophostyles Ell.

S. helvola (L.) Ell. Trailing wild bean. Waste land along the Hudson River; rather frequent. Nutten Hook, *4054;* between Hudson and Athens, *Muenscher & Clausen 4672* (CU); 2 miles south of Tivoli, *2769;* shore near Rogers Island.

GERANIACEAE (Geranium Family)

Geranium L.

1. Petals about 15 mm. long; plants perennial, from a stout woody base; fruit 25 to 30 mm. long *G. maculatum*

1. Petals mostly 6 to 12 mm. long; plants annual or biennial; fruit 17 to 25 mm. long, *2*

  2. Carpels hairy; beak of ovary hirsute; carpel not separating from beak at maturity *G. Bicknellii*

  2. Carpels and beak smooth, separating at maturity *G. Robertianum*

G. Robertianum L. Herb Robert. Moist rocks and rocky woods, in rich or calcareous soil; abundant in suitable situations.

G. maculatum L. Wild geranium, crane's-bill. Open swampy grounds and moist woods; common.

G. Bicknelli Britt. On a rocky bluff 2 miles south of Canaan, in acid soil, *3594.* Otherwise unknown.

OXALIDACEAE (Oxalis Family)

Oxalis L.

1. Flowers yellow, *2*
  2. Pedicels in fruit reflexed, but capsules erect; true rhizomes wanting *O. stricta*
  2. Pedicels spreading, not reflexed; plant with long slender horizontal stolons *O. europaea*
1. Flowers pink, or white with purple veins, *3*
  3. Flowers white or pale pink, with purple or rose-colored veins; rootstock creeping; scapes 1-flowered *O. montana*
  3. Flowers pinkish violet; base of plant bulbous; scape umbellately several-flowered *O. violacea*

O. montana Raf. Wood sorrel. Cool moist coniferous woodlands; common in the extreme northeastern part of our area, but very local elsewhere. One mile northwest of Lebanon Springs, *3669;* Bashbish Gorge, Copake, *3559;* [3 miles north of Nassau, *House 22757*]. Reported from Kinderhook by Woodworth (1840, as *O. acetosella*), but unknown there at present.

O. violacea L. Violet wood sorrel. Moist rich woods; rare, in the Hudson Valley. Kinderhook, *662.*

O. stricta L. Yellow wood sorrel. Damp shaded places in waste and cultivated grounds; infrequent.

O. europaea Jord. "Sour grass." Waste and cultivated grounds, woods, thickets and pastures; often in rich soil; common and weedy.

LINACEAE (Flax Family)

Linum L. Flax

1. Leaves subulate or linear; branchlets angular-grooved *L. sulcatum*
1. Leaves elliptic-lanceolate or narrowly oblong; stem and branchlets terete *L. virginianum*

L. sulcatum Riddell. Dry sandy or stony soil; rare, but abundant at the two following stations; 1 mile north of Kinderhook, *1208;* south end of Mount Merino, *2437.*

L. virginianum L. Dry woods; infrequent, but widely distributed. Apparently mostly in the Hudson and Harlem Valleys. Three miles north of Kinderhook, *1314;* Forest lake, *2056;* Upper Twin Pond, Elizaville, *3279;* north of Robinson Pond, *3947.*

BALSAMINACEAE (Jewelweed Family)

Impatiens L.

1. Flowers pale yellow, sparingly dotted with reddish brown *I. pallida*
1. Flowers orange, thickly spotted with reddish brown *I. capensis*

I. pallida Nutt. Yellow touch-me-not. Cool ravines and rich soil along streams; infrequent, but locally abundant. East of Valatie, *1891;* Becraft Mountain, *2248;* creek south of Madalin, *2883.* Known also from near Berry Pond, Hancock, and from several places along the Hudson River and the Roeliff Jansen Kill, in the towns of Stuyvesant, Livingston, Clermont and Copake.

I. capensis Meerb. Spotted touch-me-not, jewelweed. Wet places, in woods and in the open; common.

LIMNANTHACEAE (False Mermaid Family)

Floerkea Willd.

F. proserpinacoides Willd. False mermaid. Alluvial soil; infrequent or rare, in the Hudson Valley. Two miles south of Claverack, *4375;* 1 mile east of Clermont, *4349.*

RUTACEAE (Rue Family)

Zanthoxylum L.

Z. americanum Mill. "Prickly ash." Woods and thickets, usually in rich soil; frequent, especially in calcareous districts. Often forming pure thickets. Unknown northeastward. West Ghent, *3301;* 3 miles north of Claverack, *1303;* Spring Lake, *2744;* Shaver Pond, *841.*

SIMARUBACEAE (Quassia Family)

Ailanthus Desf.

A. altissima (Mill.) Swingle. Tree of heaven. Cultivated and locally established in waste places as a weed species.

POLYGALACEAE (Milkwort Family)

Polygala L.

1. Flowers 15 to 20 mm. long, rose-colored or purple (rarely white), 1 to 4 in a cluster at the summit of the short (7 to 15 cm.) stem; leaves ovate, crowded at the summit *P. paucifolia*

1. Flowers not more than 5 to 6 mm. long, in heads or spikes; leaves linear to oblong or oblanceolate, *2*

2. Plant perennial from a heavy woody rootstock; flowers white, in a terminal spike 2.5 to 5 cm. long; cleistogamous flowers none *P. Senega*

2. Plants annual or biennial, without heavy woody rootstocks, *3*

3. Stems numerous from the biennial root; flowers rose-colored or purplish, showy, 4 to 6 mm. long, in a loose raceme 2.5 to 10 cm. long; cleistogamous flowers usually present, on short subterranean branches *P. polygama*

3. Plants annual, slender, the stems solitary, branched above; flowers in dense heads or slender spikes, *4*

4. Flowers bright red-purple, in globular or broadly oblong heads 8 to 10 mm. across; leaves alternate *P. sanguinea*

4. Flowers white or greenish white, often tinged with pale purple, in slender spikes; some of the stem-leaves whorled *P. verticillata*

P. paucifolia Willd. Woods and shady banks; common throughout.

P. polygama Walt. Dry shaly hillsides; rare. Cedar Mountain, Copake, *3571;* 1 mile south of Germantown, *3960.*

P. verticillata L. Dry fields and hillsides; common throughout.

P. sanguinea L. Fields and meadows; infrequent and sparse. Unknown northeastward. Ashley Hill, Chatham, *2196;* 4 miles north of Kinderhook, *2366;* 1.5 miles east of Harlemville, *3918;* 2 miles north of Tivoli, *2796;* base of Stissing Mountain, *2861;* [Claverack, *Rev. A. P. Van Gieson* (V)].

P. Senega L. Seneca snakeroot. Rocky (calcareous) woods; infrequent and sparse. 3 miles north of Claverack, *548;* Old Chatham, *639;* southwest corner of town of Hillsdale, *221* (PENN); 3 miles north of Ancramdale, *821.*

EUPHORBIACEAE (Spurge Family)

1. Plant with milky juice; ovary (apparently) on a stalk projecting from a cuplike and sometimes corolla-like involucre 2. **Euphorbia**
1. Plant without milky juice; ovary sessile; cuplike involucre none; pistillate flowers surrounded by large and leaflike cut-lobed bracts 1. **Acalypha**

1. Acalypha L.

A. rhomboidea Raf. Three-seeded Mercury. Dry fields and waste places, or in woods; rather weedy. Frequent in the Hudson Valley; not reported northeastward. Kinderhook Lake, *House 13413;* Nutten Hook, *1448;* 2 miles west of Stuyvesant Falls, *3835;* Germantown, near mouth of Roeliff Jansen Kill, *1588,* north of Robinson Pond, *3932;* [Claverack, *Rev. A. P. Van Gieson* (V)].

2. Euphorbia L.

1. Peduncles axillary, the flowers not clustered in terminal inflorescences; leaves all opposite, unequal-sided, the bases oblique, *2*
2. Stems prostrate, hairy; capsule pubescent; leaves dull green, often with a purple spot *E. supina*
2. Stems procumbent or erect; capsule glabrous, *3*
3. Stems nearly erect, glabrous or essentially so; leaves 1.5 to 3.5 cm. long, usually with a purple spot *E. maculata*
3. Stems low, procumbent, hirsute; leaves 0.8 to 1.4 cm. long, green *E. vermiculata*
1. Flowers in terminal umbellate or cymose inflorescences; leaves, at least the lower, alternate, *4*
4. Uppermost leaves with conspicuous white petal-like margins; leaves all entire *E. marginata*
4. Leaves green, or the uppermost white or colored at base and, if so, toothed, *5*
5. Glands of the involucre with large white showy petaloid appendages; leaves entire, linear to oblong *E. corollata*
5. Glands of the involucre without petaloid appendages, *6*
6. Plant topped by a many-rayed umbelliform inflorescence, the floral leaves much broader than the cauline; perennials with running rootstocks, *7*
7. Principal floral leaves 13 to 20 mm. wide; cauline leaves 4 to 9 mm. wide *E. virgata*
7. Principal floral leaves 4 to 7 mm. wide; cauline leaves 1 to 2 mm. wide *E. Cyparissias*
6. Inflorescence not umbelliform, the flowering involucres in few-flowered cymes at the tips of the stems and branches; leaves all essentially similar; plants annual *E. dentata*

E. supina Raf. Dry sandy or gravelly soil, or along railroads; roadsides, waste places; weedy. Kinderhook, *1597;* Poelsburg, *3796;* Nutten Hook, *1451.*

E. vermiculata Raf. In situations like the preceding species; common.

E. maculata L. In situations like the two preceding species; frequent in the Hudson Valley; distribution eastward poorly known. Poelsburg, *3800;* Mount Merino, *2302;* [south of Castleton, *House 24174;* New Lebanon, *House 15604*].

E. marginata Pursh. Snow-on-the-mountain. Cultivated, and rarely escaping. Along Kinderhook Creek, east of Kinderhook, *2083.*

E. corollata L. Flowering spurge. Dry fields; rare. Niverville, *Brown 93;* near Fowlers' Lake, *2391.*

E. **Cyparissias** L. Established in patches along roadsides near old houses and in cemeteries; occasional. Weedy and hard to eradicate when once established.

E. **virgata** Waldst. & Kit. (*E. Esula* of *Gray's Manual*). A weed of dry fields and roadsides; in our area known only from Hillsdale, *Muenscher 16216* (CU, NYS).

E. **dentata** Michx. Along the New York Central Railroad at Hudson, *Muenscher & Clausen 4676* (CU, NYS). Forma **cuphosperma** (Engelm.) Fern. is adventive at Tivoli along the New York Central Railroad, *2974*.

CALLITRICHACEAE (Water-Starwort Family)

Callitriche L.

1. Fruit longer than broad, slightly notched at tip; the two lobes of the fruit sharply 2-keeled, the keels separated by a wide groove *C. palustris*
1. Fruit as broad as long, or broader, widely notched; the two lobes of the fruit obtusely 2-angled, with a narrow groove between the angles *C. heterophylla*

C. **palustris** L. Shallow streams and pools; frequent.

C. **heterophylla** Pursh. In similar situations; apparently local. West Ghent, *3694;* 2 miles south of Ghent, *4012;* Tackawasick and Kinderhook Lakes, Muenscher (1935).

ANACARDIACEAE (Cashew Family)

Rhus L.

1. Leaves pinnate, with 7 to 31 leaflets, *2*
  2. Leaf rachis plainly wing-margined *R. copallina*
  2. Leaf rachis terete or nearly so, *3*
    3. Leaflets entire; fruit grayish white *R. Vernix*
    3. Leaflets serrate; fruit covered with crimson hairs, *4*
      4. Branchlets and petioles villous-hirsute *R. typhina*
      4. Branchlets and petioles glabrous *R. glabra*
1. Leaves 3-foliolate, *5*
  5. Terminal leaflet on a distinct petiolule often 1 cm. in length or more; fruit grayish white, glabrous or nearly so; flowers greenish, in loose clusters, appearing in June or July after the leaves are grown *R. Toxicodendron*
  5. Terminal leaflet wedge-shaped at base, scarcely petiolulate; fruit crimson-hirsute; flowers light yellow, in dense short spikes, appearing in April or May, before the leaves *R. aromatica*

R. **copallina** L. Rocky summits in the southeastern part of our area, at elevations of 300 meters or more; rare. Stissing Mountain, *2840;* 2 miles southwest of Hillsdale, *3553*. Known also from Cedar Mountain, Copake.

R. **typhina** L. Staghorn sumac. Old fields, roadsides and thickets, in dry soil; common.

R. **glabra** L. Smooth sumac. In situations similar to the preceding; very common in the Hudson Valley, but not reported eastward.

R. **aromatica** Ait. Fragrant sumac. Rocky bluffs along the Hudson River; there frequent and locally abundant. Elsewhere known only from a rocky hill 1 mile east of Pulvers, Ghent, and from East Nassau, *2194*. Poelsburg, *574;* Nutten Hook, *357* (PENN); Alvords' Dock, Stockport, *767;* south end of Mount Merino, *2435* (PENN); 1 mile south of Germantown, *3321;* Magdalen Island, *2677*.

R. Vernix L. Poison sumac. Swampy places; common. Very abundant in suitable localities, seeming to prefer large undisturbed swampy areas, whether of acid or calcareous soil.

R. Toxicodendron *L. (R. radicans* of *Gray's Manual).* Poison ivy. Woods and fence rows and on rocky banks; common.

AQUIFOLIACEAE (Holly Family)

1. Leaves relatively broad, ovate to obovate, pointed, conspicuously serrate; petals oval or obovate; stamens adhering to the base of the corolla 1. **Ilex**

1. Leaves relatively narrow, elliptic-oblong, entire or nearly so; petals oblong-linear; stamens free from the corolla 2. **Nemopanthus**

1. Ilex L. Holly

1. Parts of the fertile flowers mostly in 4's or 5's; nutlets striate-ribbed on the back *I. montana*

1. Parts of the fertile flowers mostly in 6's; nutlets smooth and even *I. verticillata*

I. montana T. & G. Upland woods in the southern Taconic Mountains. Near Guilder Pond, Mount Washington, *J. A. Cushman 9820* (GH); near Plantain Pond, Mount Washington, *Phelps and Weatherby 3020* (GH); Plantain Pond, *Hoffman,* Aug. 11, 1914 (GH). The species was reported by Hoysradt (1875-79) from Stissing Mountain. The data in regard to the specimens at the Gray Herbarium were kindly furnished by Mr. C. A. Weatherby. The species is represented in our area by var. **mollis** (Gray) Britton.

I. verticillata (L.) Gray. Winterberry, "black alder." Open swamps and wet woods; frequent. Several reports of *I. laevigata* (Pursh) Gray are seemingly based upon occurrences of *I. verticillata.*

2. Nemopanthus Raf.

N. mucronata (L.) Trel. Mountain holly. Swampy woods and sphagnum bogs; locally abundant. Lebanon Springs; No Bottom Pond; 2 miles south of Copake Lake; 1.5 miles south of Ancramdale; North Chatham; Niverville; bog southeast of Knickerbocker Lake.

CELASTRACEAE (Staff Tree Family)
Celastrus L.

C. scandens L. Bittersweet. Dry woods and fence rows; common.

STAPHYLEACEAE (Bladdernut Family)
Staphylea L.

S. trifolia L. Bladdernut, rattleberry. Moist or rocky woods, often in rich or calcareous soil; frequent in the Hudson and Harlem Valleys; infrequent or rare eastward and northeastward. Poelsburg, *575;* North Chatham, *House 20465;* Stuyvesant Falls, *Iva Allen;* 3 miles north of Claverack, *558;* 1 mile east of Pulvers Station, Ghent, *2347;* Miller Pond, Ancram, *1657* (PENN); Magdalen Island, *2681.*

ACERACEAE (Maple Family)

Acer L.

1. Leaves simple, palmately lobed, *2*
  2. Flowers in racemes, appearing after the leaves, *3*
    3. Racemes drooping; bark green, striped with white *A. pensylvanicum*
    3. Racemes erect; bark reddish brown, not striped *A. spicatum*
  2. Flowers in corymbs or umbel-like clusters, appearing before or with the leaves, *4*
    4. Flowers capitate, in dense clusters, scarlet or red to yellowish, much preceding the leaves; leaves whitened beneath, *5*
      5. Leaves deeply cleft, the lobes coarsely toothed; petals none; fruit woolly when young *A. saccharinum*
      5. Leaves sharply lobed; petals present; fruit glabrous even when young *A. rubrum*
    4. Flowers drooping, on long slender hairy pedicels, light yellowish green, appearing with the leaves, *6*
      6. Leaves pale and slightly glaucous beneath, glabrous; stipules small, not covering the axillary bud *A. saccharum*
      6. Leaves usually yellowish green and pubescent beneath, not glaucous; stipules when full grown often covering the axillary bud *A. nigrum*
1. Leaves pinnately compound *A. Negundo*

A. saccharinum L. Silver maple. Banks of large streams; frequent in the Hudson Valley. Hotaling Island, *358;* 3 miles north of Castleton, *3969;* Kinderhook, along creek, *1256;* Columbiaville, *3700.*

A. rubrum L. Red maple, swamp maple. Swamps and wet woods; common throughout.

A. saccharum Marsh. Sugar maple, hard maple. Woods; common. Reaching its best development in rich upland woods.

A. nigrum Michx.f. Black maple. A little-known tree in our area and perhaps merely a variety of the preceding. *House 21295,* from New Lebanon, is apparently this species.

A. pensylvanicum L. Striped maple. Rich moist woods; frequent throughout, but most abundant eastward; local in the Hudson Valley. Gorge near Hudson River, at Columbia-Rensselaer County line; Blue Hill; Becraft Mountain; Tivoli; Stephentown Center; Canticoke Swamp.

A. spicatum Lam. Mountain maple. Cool moist woods; often on talus below rock ledges, especially in calcareous regions. Common in the higher hills to the eastward, and decreasing westward; occurs rarely in rocky gorges along the Hudson River as at Cheviot, *2823,* and Tivoli, *2740.*

A. Negundo L. Box elder. Often cultivated. Well established at several points along the Hudson River, as at the mouth of the Muitzes Kill; perhaps always an introduced species, but Gordinier and Howe (1894) report it from Rensselaer county upon the authority of Dr. John Wright as early as 1836.

RHAMNACEAE (Buckthorn Family)

1. Flowers axillary, greenish; fruit fleshy; ovary free from the calyx and disk **1. Rhamnus**
1. Flowers mostly in terminal, paniculate or corymbose umbels, white; fruit dry; calyx and disk adherent to base of ovary **2. Ceanothus**

1. Rhamnus L.

1. Calyx lobes, stamens and petals 4 *R. cathartica*
1. Calyx lobes and stamens 5; petals wanting *R. alnifolia*

R. cathartica L. Buckthorn. Dry woods and old pastures; occasionally established and sometimes appearing as if indigenous, as at New Lebanon, *737*.

R. alnifolia L'Hér. Calcareous marshes, where rather abundant. Four miles north of Kinderhook, *722;* 1 mile east of Fowlers' Lake, *567;* 3 miles north of Ancramdale, *812;* south of Mount Riga Station, *3366.*

2. Ceanothus L.

C. americanus L. New Jersey tea. Dry hillsides and margins of woods; frequent. Locally very abundant, sometimes taking over whole fields in dry gravelly soil.

VITACEAE (Grape Family)

1. Leaves simple, often lobed — 1. **Vitis**
1. Leaves palmately compound — 2. **Parthenocissus**

1. Vitis L. Grape

1. Tendril or inflorescence normally opposite each leaf; leaves permanently densely rusty-tomentose beneath; berries 12 to 20 mm. in diameter — *V. Labrusca*
1. Tendrils and inflorescences intermittent, none opposite each third leaf, *2*
  2. Leaves loosely rusty-tomentose beneath, or glabrate in age; berries 8 to 12 mm. in diameter — *V. aestivalis*
  2. Leaves green beneath, glabrous beneath or sometimes pubescent on the veins; berries 6 to 10 mm. in diameter, blue — *V. riparia*

V. Labrusca L. Fox grape. Woods and thickets, often high-climbing; frequent throughout. Perry Peak, Canaan; Brainard; Kinderhook; Stissing Mountain.

V. aestivalis Michx. Summer grape. Woods and thickets; rather local, climbing on trees and bushes. Kinderhook Lake; Alvords' Dock, Stockport; Fowlers' Lake; 1 mile south of Taghkanic Lake; Blue Hill; Canaan; Ancram. The plant with smoothish glaucous leaves, var. **argentifolia** (Munson) Fern., also occurs locally, as at Brainard, *House 21918.*

V. riparia Michx. Frost grape. Woods and thickets, often forming dense tangles in fence rows; common.

2. Parthenocissus Planch.

1. Plants with adhesive tendrils, often high-climbing on trees and rocks; cymes irregular, paniculate, with unequal branches (not dichotomous); fruit 5 to 7 mm. in diameter — *P. quinquefolia*
1. Plants without adhesive tendrils, not high-climbing but resting loosely on bushes, fences and rocks; cymes regularly dichotomous; fruit mostly 8 to 10 mm. in diameter — *P. vitacea*

P. quinquefolia (L.) Planch. Virginia creeper. Woodlands and fence rows; common. Most abundant in the Hudson Valley, so far as known.

P. vitacea (Knerr) Hitchc. (*P. inserta* of *Gray's Manual*). With the preceding; distribution in our area poorly known, but probably occurs throughout. [North Chatham, *House 20473*].

TILIACEAE (Linden Family)

Tilia L.

T. americana L. Basswood, American linden. In rich or rocky woods, in various soils; common.

MALVACEAE (Mallow Family)

1. Column of stamens bearing anthers at the top only; carpels 10 to 20, separating from the central axis in fruit, *2*
2. Flowers yellow; leaves velvety; carpels 3- to 9-seeded, splitting open at maturity **2. Abutilon**
2. Flowers whitish or pinkish; leaves not velvety; carpels 1-seeded, indehiscent **1. Malva**
1. Column of stamens bearing anthers over much of its length, and naked and 5-toothed at the very apex; carpels not falling away separately from the axis, but forming a 5-locular capsule **3. Hibiscus**

1. Malva L.

1. Flowers in clusters in the axils of the leaves, whitish or pale bluish purple, less than 2 cm. across; stems procumbent *M. neglecta*
1. Flowers clustered toward the ends of the branches, pink or white, 3.5 to 5 cm. across; stems erect *M. moschata*

M. neglecta Wallr. Dwarf mallow, cheeses. Waste and cultivated grounds; a common weed.

M. moschata L. Musk mallow. An occasional adventive in fields and along roadsides, but not well established anywhere. New Concord, *4763* (USNA).

2. Abutilon Mill.

A. Theophrasti Medic. Velvetweed. A weed in cultivated ground; locally abundant.

3. Hibiscus L.

1. Flowers pale yellow with dark reddish brown eye, not more than 4 cm. across; a weedy annual *H. Trionum*
1. Flowers rose-colored to white, up to 20 cm. across; a native perennial *H. palustris*

H. Trionum L. Flower of an hour. A weed in gardens and cultivated grounds; locally abundant. Kinderhook, *1449*.

H. palustris L. Marsh mallow. In our area known only from tidal marshes east of Crugers' Island, *2900*. Increasingly common south of our area, in the Hudson estuary.

HYPERICACEAE (St. John's-wort Family)

Hypericum L.

1. Petals yellow, often black-dotted, *2*
2. Styles 5; capsule 5-locular; petals 25 mm. long *H. pyramidatum*
2. Styles 3; capsules trilocular; petals 15 mm. long or less, *3*
3. Stamens very numerous (more than 12), *4*
4. Petals with black dots or lines; stamens in 3 to 5 clusters, *5*
5. Flowers 15 to 25 mm. broad; leaves mostly 1 to 2 cm. long; petals bearing black dots only on margin *H. perforatum*
5. Flowers 8 to 15 mm. broad; leaves mostly 2.5 to 5 cm. long; petals bearing several rows of black dots or lines *H. punctatum*
4. Petals without black dots; stamens obscurely if at all clustered; leaves elliptic-oblong *H. ellipticum*
3. Stamens 5 to 12, *6*
6. Leaves scalelike or linear-subulate, scarcely leaflike, strongly ascending; stem and bushy branches threadlike, wiry *H. gentianoides*

6. Leaves linear to ovate, spreading, leaflike; stem and branches not as above, *7*

7. Bracts of the inflorescence foliaceous, resembling reduced leaves *H. boreale*

7. Ultimate bracts of the inflorescence narrowly linear or setaceous, very different from the leaves, *8*

8. Leaves broadly ovate to orbicular; plants diffusely branched *H. mutilum*

8. Leaves lanceolate; branching strict, the branches erect *H. majus*

1. Petals flesh-colored or purplish; stamens mostly 9 *H. virginicum*

H. pyramidatum Ait. Alluvial or rocky soil near large streams; infrequent. Below Malden Bridge, *1895;* Valatie, *1883;* Germantown, near mouth of Roeliff Jansen Kill, *1584;* Ancram, *1640* (PENN).

H. perforatum L. St. John's-wort. Dry soil in fields and waste ground; a common weed. Naturalized from Europe.

H. punctatum Lam. Moist soil, in woods and shady places along streams; common.

H. ellipticum Hook. Borders of ponds and lakes; infrequent or rare. Kinderhook, *1374;* Stephentown, *House, 22823;* Pine Plains, *Hoysradt* (MICH). Reported also from Kinderhook Lake and Brainard.

H. boreale (Britt.) Bickn. In our area known only from muddy margins of No Bottom Pond, *1948,* and from Kinderhook Lake, *House 18859.* Increasingly common northward from our area.

H. mutilum L. Wet soil in ditches and meadows and near ponds and streams; common.

H. majus (Gray) Britt. Moist meadows and banks of streams; infrequent or rare. East Nassau, *House 21939;* North Chatham, *House 20462;* Hillsdale, *3543;* [Brace Mountain, *House 24812*].

H. gentianoides (L.) BSP. Dry sandy or gravelly soil; frequent in the Hudson and Harlem Valleys; not reported northeastward.

H. virginicum L. Swampy places; common. Canticoke Swamp (PENN); 1 mile south of Taghkanic Lake; Knickerbocker Lake; seen also in the towns of New Lebanon, Ghent, Claverack and Ancram. [Specimens from Copake Falls, *3913,* and No Bottom Pond, *1956,* correspond to the var. **Fraseri** (Spach) Fern.].

ELATINACEAE (Waterwort Family)

Elatine L.

1. Flowers trimerous; seeds slender-cylindric with 20 to 30 acute cross-ribs *E. triandra*

1. Flowers dimerous; seeds thick-cylindric or barrel-shaped, with 15 to 18 obtuse cross-ribs *E. minima*

E. triandra Schkuhr (inc. *E. americana* of *Gray's Manual*). Tidal mud along the Hudson River, there common and forming small patches below high-tide level. Poelsburg, *3810;* Stuyvesant, *1813;* Columbiaville, *3702;* Rogers Island, *3740;* Tivoli, *2792;* [mouth of Stockport Creek, *Muenscher & Clausen 4519* (CU, NYS)]. Represented in our area by var. **americana** (Pursh) Fassett.

E. minima (Nutt.) Fisch. & Mey. Shallow water, sandy bottoms of lakes and ponds; apparently infrequent. Pikes' Pond, Nassau, *House 21956;* Nassau Lake, *Muenscher & Clausen 4523;* [Tackawasick Lake, *House 24240*]; also reported by Muenscher (1935) from Copake Lake.

CISTACEAE (Rockrose Family)

1. Petals 5, fugacious, yellow, large and showy in the larger flowers **1. Helianthemum**

1. Petals 3, withering-persistent, minute, greenish or purplish **2. Lechea**

1. Helianthemum Mill.

1. Larger flowers 5 to 12, in a short terminal raceme, each 1.5 to 2.5 cm. in diameter, with capsules 3 to 5 mm. in diameter; these flowers little if at all overtopped by the later-growing branches *H. Bicknellii*

1. Larger flowers solitary or rarely 2, 2 to 4 cm. in diameter, with capsules 6 to 9 mm. in diameter; these flowers soon conspicuously overtopped by later-growing branches and becoming apparently lateral *H. canadense*

H. Bicknellii Fern. Frostweed. Dry sandy or gravelly soil, often in old fields; infrequent. One mile north of Kinderhook, *1186;* 1 mile northwest of Ghent, *2998;* Robinson Pond, *3931;* 1.5 miles south of Ancramdale, *3391.*

H. canadense (L.) Michx. Dry sandy soil on bluffs overlooking the Hudson River. North of Nutten Hook, *4058;* at Columbia-Rensselaer County line, *1688.*

2. Lechea L. Pinweed

1. Cauline leaves broadly lanceolate to elliptic; pubescence strongly spreading; outer sepals about equaling the inner ones *L. villosa*

1. Cauline leaves narrowly lanceolate to narrowly linear; outer sepals shorter than the inner ones, *2*

2. Seeds 2 to 4, smooth at maturity *L. Leggettii*

2. Seeds 4 to 6, at maturity with a white-reticulate membranaceous covering *L. intermedia*

L. villosa Ell. Known in our area only from Stissing Mountain, *Hoysradt,* Sept. 16, 1878 (PENN).

L. Leggettii Britt. & Hollick. A plant in the herbarium of the University of Pennsylvania, collected at Pine Plains by Hoysradt, July 16, 1878, has been referred to this species, but may represent an aberrant or immature form of the next.

L. intermedia Leggett. Dry fields, thickets and edges of woods; common throughout. Often very abundant in clearings.

VIOLACEAE (Violet Family)

1. Flowers greenish white, small; petals about equal in length, none of them spurred; sepals not auricled; plants 40 to 80 cm. high, leafy to the top . **1. Hybanthus**

1. Flowers white, yellow or blue, not greenish; lower petal prolonged into a spur at base; sepals with auriculate lobes; plants acaulescent or low-stemmed, rarely over 40 cm. high **2. Viola**

1. Hybanthus Jacq.

H. concolor (T. F. Forst.) Spreng. Green violet. Known only through a collection by *Lewis C. Beck,* now in the herbarium of the New York State Museum, marked "Lebanon, N. Y." In the 28th Report of the N. Y. State Museum, p. 82 (1879), the species is reported from "New Lebanon, near the Shaker Settlement." *Hoysradt* (1874a, p. 37) reports it from "a cold mountainous woods about a mile from the village of Pine Plains."

2. Viola L. Violet

1. Plants stemless; leaves and flower stalks all from rootstocks or runners, *2*
2. Flowers yellow *V. rotundifolia*
2. Flowers blue or white, *3*
3. Flowers blue, sometimes pale but not white; rootstocks short and stout, not long-creeping, *4*
4. Leaves heart-shaped in outline, crenate-serrate but without lobes or conspicuous teeth near the base, *5*
5. Plants glabrous or essentially so, *6*
6. Beard of lateral petals, or a part of it, usually composed of strongly club-shaped hairs; sepals often ciliate-serrulate toward the apex; flowers usually with a dark eye, on stalks much exceeding the leaves *V. cucullata*
6. Beard composed of cylindrical hairs; sepals entire toward the apex; flowers without a dark eye, on stalks which are usually about as long as the leaves, *7*
7. Early leaves purplish beneath; petioles and flower stalks minutely granulose along the upper part *V. latiuscula*
7. Early leaves green beneath; petioles and flower stalks not granulose but sometimes sparingly pubescent *V. papilionacea*
5. Plants more or less pubescent, *8*
8. Spurred petal villous; capsules 5 to 8 mm. long *V. septentrionalis*
8. Spurred petal glabrous or with a few scattered hairs; capsules 8 to 12 mm. long *V. sororia*
4. Leaves with conspicuous lobes or sharp protruding teeth near base, *9*
9. Leaves, except rarely the earliest, palmately 5- to 11-lobed or parted; spurred petal glabrous *V. palmata*
9. Leaves with conspicuous sharp teeth or short lobes at base of blade, but the blade not strongly palmately parted; spurred petal villous, *10*
10. Leaves ovate-oblong, pubescent, spreading-ascending, on short petioles *V. fimbriatula*
10. Leaves lanceolate, usually glabrous, stiffly erect on long petioles *V. sagittata*
3. Flowers white, sweet-scented; rootstocks slender, often filiform and long-creeping, *11*
11. Leaves entirely glabrous, usually much exceeded by the flower stalks, the blades heart-shaped, obtuse; plants green *V. pallens*
11. Leaves more or less hairy, larger, usually not exceeded by the flower stalks, usually pointed, *12*
12. Leaf blades glabrous except for a few hairs above; petioles and flower stalks usually reddish; lateral petals beardless *V. blanda*
12. Leaves hairy below and on the petioles; petioles and flower stalks not reddish; lateral petals bearded *V. incognita*

1. Plants with leafy stems; flowers axillary, *13*
13. Flowers yellow, *14*
14. Plants strongly soft-pubescent; root leaves usually none *V. pubescens*
14. Plants sparingly pubescent; root leaves usually 1 to 3 *V. pensylvanica*
13. Flowers white, blue or violet, *15*
15. Petals white within, violet without; stipules entire, at least the lower ones scarious *V. canadensis*
15. Petals light blue, lavender or violet; stipules bristly-toothed, herbaceous, *16*
16. Spur 4 to 8 mm. long; lateral petals bearded *V. conspersa*
16. Spur 9 to 13 mm. long; lateral petals beardless *V. rostrata*

V. palmata L. Rich wooded hillsides; common.

V. papilionacea Pursh. Meadow violet. Moist or wet soil in meadows, thickets, or along streams, often in shaded situations; common. Very abundant in the Hudson Valley but apparently less so eastward.

V. latiuscula Greene. Dry wooded hillsides; infrequent. 4 miles north of Nassau, *House 22761;* Waldorf Pond, *House 21152;* Hudson, below South Bay, *House 20489;* north of Castleton, *3978.*

V. sororia Willd. Woolly blue violet. Meadows, thickets and banks, in rather dry soil; frequent, but local. In our area scarcely to be separated from *V. papilionacea,* which appears to be hardly more than a glabrous phase of the same species. The glabrous phase greatly exceeds the woolly one in number of individuals. Waldorf Pond, *House 21153;* 3 miles north of Claverack, *552.*

V. septentrionalis Greene. Moist woods and upland pastures and meadows; rather frequent. Known only from the eastern part of our area, at elevations of about 300 m. or above. Mount Lebanon, *House 16139;* Perry Peak, Canaan, *House 21172;* 2 miles south of Flatbrook, *3601;* 2 miles east of Austerlitz, *697.*

V. cucullata Ait. Swamp blue violet. Wet open places in swampy meadows and along streams; frequent. Rather abundant locally, but much less so than *V. papilionacea,* from which it is usually to be distinguished by the whitish eye of the corolla, the clavate hairs of the lateral petals and the long auricles at the base of the sepals. It is also a plant of moist or wet open places, rather than one preferring light shade as does *V. papilionacea.*

V. fimbriatula Sm. Dry fields, pastures and hillsides; in various soils, but often in clays and other heavy soils; common throughout. Abundant in most dry open grasslands.

V. sagittata Ait. Dry fields and pastures; rare in the Hudson Valley. South of Curtis Mountain, *House 21475;* Waldorf Pond, *House 21133;* 1 mile north of Kinderhook, in sandy pasture, *4317.* This species seems wholly distinct from the preceding one, both in shape and pubescence of leaves and in habit; *V. fimbriatula* forms a rosette of leaves on the ground, whereas both leaves and flowers of *V. sagittata* stand stiffly erect.

V. incognita Brainerd. Cool moist woods; rare. Well known north of our area in Rensselaer County. One mile northwest of Brainard, *House 21415.*

V. blanda Willd. Sweet white violet. Cool moist woods, in rich soil; common. Our most abundant white violet.

V. pallens (Banks) Brainerd. Sweet white violet. Springy places in woods and along streams and on hummocks in swamps; frequent.

V. rotundifolia Michx. Round-leaved yellow violet. Cool moist woods; common eastward, at elevations of 300 m. and above. In the Hudson Valley known only from Stuyvesant Falls, *446.*

V. pensylvanica Michx. Yellow violet. Rich woods, in moist soil; common. In our area represented by var. **leiocarpa** (Fern. & Wieg.) Fern.

V. pubescens Ait. Downy yellow violet. Rich woods, usually in drier soil than the preceding species; common.

V. canadensis L. Canada violet. Rich moist woods, usually in somewhat calcareous soil, in the eastern part of the area; infrequent. Unknown in the Hudson Valley. East side of Douglas Knob, New Lebanon, *4286* (GA); 2 miles south of Flatbrook, *3608;* No Bottom Pond, *466* (PENN); known also from Old Chatham, on limestone talus, and reported from Bashbish Gorge, Copake, by Knowlton (1919).

V. conspersa Reichenb. Dog violet. Moist rich woods and low grounds; common.

V. rostrata Pursh. Long-spurred violet. Dry sunny rocky woods and banks; frequent eastward, at elevations of 200 meters and above. Unknown from the Hudson Valley. New Lebanon; Canaan; Spencertown; Washburn Mountain; Red Rock; Riders Mills; Old Chatham.

CACTACEAE (Cactus Family)

Opuntia Mill.

O. humifusa (Raf.) Raf. Cactus, "prickly pear." Dry shaly slopes of Mount Merino, where known as early as 1825 (Stebbins, 1830). Saugerties, Ulster County, according to Taylor (1915). Well known farther south in the Hudson Valley.

THYMELAEACEAE (Mezereum Family)

1. Flowers light yellow; stamens and style exserted; flowers from an involucre of dark fuzzy-hairy bracts; upright native shrub with exceedingly tough bark and jointed branchlets 1. **Dirca**

1. Flowers purplish or rose-colored; stamens and style included; low shrub, sparingly introduced along roadsides 2. **Daphne**

1. Dirca L.

D. palustris L. Leatherwood. Rich moist woods; frequent, but nowhere abundant. Throughout, but most abundant on clay soil in the ravines of the Hudson Valley. Poelsburg; Niverville; Ashley Hill, Chatham (GH); Perry Peak, Canaan; 2 miles south of Flatbrook; Chatham; Mount Merino (GA); Becraft Mountain; 3 miles east of Elizaville.

2. Daphne L.

D. Mezereum L. Cultivated; established near New Britain, *House 23640.*

LYTHRACEAE (Loosestrife Family)

1. Plants annual, small, rarely over 30 cm. high; whole plant strongly sticky-hairy; flowers somewhat irregular, the petals unequal and the calyx enlarged at base on the upper side 1. **Cuphea**

1. Plants tall and coarse, the stems often 60 to 200 cm. long; plants smooth or downy, not sticky; flowers regular, *2*

2. Calyx long-cylindric; plants stiffly erect, with the numerous flowers in a large conspicuous terminal inflorescence 2. **Lythrum**

2. Calyx short, bell-shaped; plants recurved, drooping; flowers in clusters in the axils of the upper leaves. 3. **Decodon**

1. Cuphea P. Br.

C. petiolata (L.) Koehne. Tarweed. Fields and meadows; occasional in the Hudson Valley. Unknown from the eastern tier of towns. West Ghent, *4003;* Becraft Mountain, *2237;* Glenco Mills, *4033;* 2 miles east of Germantown, *2922;* 2 miles north of Tivoli, *2977.* Seen also at Castleton.

2. **Lythrum** L.

L. Salicaria L. Purple loosestrife. Marshes along the Hudson River; common, often forming dense stands and becoming the dominant plant over large areas. Unknown away from the river except in isolated colonies. This species, now the most conspicuous one in the river marshes, is apparently spreading rapidly. It was not mentioned by Hoysradt in his flora of Pine Plains (1875-79), nor by Gordinier & Howe ("Flora of Rensselaer County," 1894). According to Dr. H. D. House it was uncommon enough before 1920 to be an interesting "find" for a collector. It is now (1937) probably more numerous in individuals than any of the surrounding native species of the river marshes and is gradually extending its range away from the river.

3. **Decodon** J. F. Gmel.

D. verticillatus (L.) Ell. Floating sphagnum bogs and margins of lakes; infrequent. Locally very abundant, forming dense stands on the margins of some bogs. Not reported from the higher elevations eastward. Bog southeast of Knickerbocker Lake, *1754;* bog south of Niverville, *1802;* Taghkanic Lake, *2009*. Known also from the towns of Ghent, Livingston and Copake.

ONAGRACEAE (Evening Primrose Family)

1. Parts of the flowers in 4's or more numerous, *2*
  2. Calyx-tube scarcely or not at all prolonged beyond the ovary, *3*
    3. Capsule obovoid-cubical; seeds naked; sepals persistent; petals minute and reddish, or yellow, or wanting — 1. **Ludwigia**
    3. Capsule linear; seeds with a tuft of hairs; sepals deciduous; petals purple or white, obovate or obcordate — 2. **Epilobium**
  2. Calyx-tube conspicuously prolonged beyond the ovary; seeds naked, *4*
    4. Flowers yellow; capsule dehiscent — 3. **Oenothera**
    4. Flowers pale pink; fruit hard and nutlike, indehiscent — 4. **Gaura**
1. Parts of the flowers in 2's — 5. **Circaea**

1. **Ludwigia** L.

1. Leaves all alternate; plant erect, terrestrial — *L. alternifolia*
1. Leaves all opposite; plant amphibious; stems creeping or floating — *L. palustris*

L. alternifolia L. Open swampy places; rare, in the Hudson Valley. Merwins' Lake, *2006;* 1 mile south of Kinderhook, *4026;* 2 miles south of Claverack, *3984*. Hudson, according to Stebbins (1830); Pine Plains, according to Hoysradt.

L. palustris (L.) Ell. Wet places, in various situations, often in mud; common. In our area represented by var. **americana** (DC.) Fern. & Grisc.

2. **Epilobium** L.

1. Petals 1 to 2 cm. long; stigma 4-lobed, *2*
  2. Stamens and style bent downward; petals not notched at tip; plants glabrous or short-puberulent above — *E. angustifolium*
  2. Stamens and style not bent downward; petals notched at tip; stem densely hirsute with long spreading hairs — *E. hirsutum*

1. **Petals less than 1 cm. long; stigma entire, not 4-lobed, *3***
3. Stems terete, with no decurrent lines from the leaf-bases; leaves narrow, lanceolate or linear, with revolute margins, *4*
4. Stems and pods covered with fine short straight spreading hairs *E. strictum*
4. Stems and pods with appressed or incurved hairs, or glabrous, *5*
5. Leaves closely and evenly pubescent above; well-developed plants freely branching *E. leptophyllum*
5. Leaves glabrous above or nearly so; plants simple or nearly so *E. palustre*
3. Stems with decurrent lines running down from the leaf-bases; leaves lanceolate to ovate, mostly toothed, the margins not revolute, *6*
6. Seed about 1.5 mm. long, not striate; leaves narrowed at base, closely but irregularly serrate *E. coloratum*
6. Seed about 1 mm. long, distinctly striate; leaves rounded at base, nearly or quite sessile, somewhat remotely serrate *E. glandulosum*

E. **angustifolium** L. Fireweed. Woods and low ground, especially in recently cleared or burned land; frequent eastward, but rare and obviously of recent introduction in the Hudson Valley. Kinderhook, in fence-row, *1395;* Hotaling Island, *3131.*

E. **hirsutum** L. Marshes and roadsides along the Hudson River; rather frequent. Unknown elsewhere. Apparently first reported from eastern New York by Peck (20th Report N. Y. State Museum, App. p. 160. 1868).

E. **palustre** L. var. **oliganthum** (Michx.) Fern. Known only from a sphagnum bog 3 miles southeast of Harlemville, *House 20587.*

E. **leptophyllum** Raf. Open swamps and wet meadows, and swampy woods; common.

E. **strictum** Muhl. Swampy meadow 1 mile east of Austerlitz, *2287.* Doubtless elsewhere, especially in the eastern part of the area.

E. **coloratum** Biehler. Moist woods and meadows, and borders of streams and ponds; common.

E. **glandulosum** Lehm. With the preceding species; common. Represented in our area only by the var. **adenocaulon** (Haussk.) Fern.

3. **Oenothera** L.

1. Plants slender, 10 to 60 cm. high; capsule club-shaped to obovoid, its greatest diameter above the middle; seeds clustered, not in distinct rows; petals 5 to 10 mm. long *Oe. perennis*
1. Plants coarse, 30 to 150 cm. high; capsule elongated, subcylindrical, with nearly parallel sides; seeds in two rows in each locule; petals 12 to 25 mm. long, *2*
2. Sepals with terminal appendages (resembling soft spiny points) which are in contact in the bud *Oe. biennis*
2. Sepals with appendages slightly back of the tip and therefore separated in the bud *Oe. parviflora*

Oe. perennis L. Sundrops. Dry or moist soil, in meadows, open swamps and margins of woods; common, throughout.

Oe. biennis L. Evening primrose. Dry places in fields and woods, cultivated and waste grounds; common. Very variable as to color of stems, amount of pubescence and size of bracts.

Oe. parviflora L. Said to grow in sandy and gravelly, often calcareous soils; reported several times from our area, but actually known only from a single collection, on the shales at Poelsburg, *4536.*

4. Gaura L.

G. biennis L. Moist alluvial soil along the Hudson River; rather frequent. Mouth of the Muitzes Kill, *House 24208;* Stuyvesant, *House 13296;* Tivoli, *2775.* Seen also at Poelsburg

5. Circaea L.

1. Leaves firm in texture, mostly rounded at base, shallowly toothed; fruit bilocular, 3.5 to 5 mm. thick, including the bristle-like hairs *C. quadrisulcata*
1. Leaves thin, flaccid, usually somewhat cordate at base, coarsely sharp-toothed; fruit 1 to 3 mm. thick, *2*
  2. Fruit bilocular, 1.5 to 3 mm. thick, the hairs evident *C. canadensis*
  2. Fruit unilocular, 1 to 1.5 mm. thick, the hairs very short and soft *C. alpina*

C. quadrisulcata (Maxim.) Franch. & Sav. "Enchanter's nightshade." Moist woods; very common, especially in rich or alluvial soil. In our area represented by var. **canadensis** (L.) Hara.

C. canadensis Hill. "Rocky bed of Bashbish Brook, Mount Washington," *Hoffmann* (NEBC). Otherwise unknown.

C. alpina L. Cool moist woods, mossy swamps and wet rocks; common in the eastern towns, at elevations of 300 meters and over, but decreasing westward. Unknown in the Hudson Valley.

HALORAGIDACEAE (Water-milfoil Family)

1. Flowers 4-parted **1. Myriophyllum**
1. Flowers 3-parted **2. Proserpinaca**

1. Myriophyllum L. Water-milfoil

1. Leaves whorled, pectinate; flower bracts entire or denticulate; stamens 8; flowers whorled in an apparently naked spike *M. exalbescens*
1. Leaves alternate or subopposite (or wanting on flowering stems), simple or pinnate; stamens 4; flowers alternate, *2*
  2. Flowering stems naked or with a few filiform uncleft leaves *M. tenellum*
  2. Flowering stems leafy *M. humile*

M. exalbescens Fern. Lakes and slow streams; rare, but locally abundant. Stony Creek, 1 mile north of Madalin, *2762;* Copake Lake, *3426;* Stissing Pond, *Peck.*

M. tenellum Bigel. Ponds; rare and little known. Pikes' Pond, Nassau, *House 21954;* Tackawasick Lake, *Muenscher & Clausen 4543* (CU).

M. humile (Raf.) Morong. Known only from tidal mud along Stony Creek, *Svenson 6430* (according to Svenson, 1935), and from the rocky edges of Riga Lake, Litchfield County, Connecticut, *4480.*

2. Proserpinaca L.

P. palustris L. Mermaid weed. Open swamps and borders of ponds, in neutral and calcareous situations; infrequent. Fowlers' Lake, *2392*; 3 miles north of Ancramdale, *3344;* seen 1 mile south of Mount Riga Station. Represented in our area by var. **crebra** Fern. & Grisc.

ARALIACEAE (Ginseng Family)

1. Leaves alternate, more than once compound; carpels 5 **1. Aralia**
1. Leaves whorled, once compound; carpels 2 to 3 **2. Panax**

1. Aralia L.

1. Umbels numerous in a large compound panicle; fruit dull red when ripe; leaves very large, decompound; plant herbaceous *A. racemosa*
1. Umbels mostly 2 to 7, corymbose or umbellate in arrangement; fruit dark bluish black; stems somewhat woody at base, *2*
2. Stem leafy, 40 to 90 cm. high, often bristly at base, terminated by the inflorescence *A. hispida*
2. Plant nearly acaulescent, bearing a single ternate leaf with each of the divisions having 5 leaflets; inflorescence scapose, overtopped by the leaf *A. nudicaulis*

A. racemosa L. Spikenard. Moist rich woods and cool ravines; frequent. One mile north of Kinderhook, *1785;* Stuyvesant Falls, *991;* 1 mile south of Stockport Station, *1507;* Canaan Center, *2314;* Tivoli, *2810.* Not seen in regions of prevailingly acid soil.

A. hispida Vent. Rocky summits and dry rocky woods; infrequent. Four miles north of Lebanon Springs, *3788;* southeast of Brainard, *House 21540;* Stuyvesant Falls, *996*; Rogers Island, *2554*; 2 miles southeast of Churchtown, *3512;* Boston Corners, *2272.*

A. nudicaulis L. Wild sarsaparilla. Woods; common. Probably the most universally present herbaceous species in all woodlands.

2. Panax L.

1. Stem 20 to 40 cm. tall; leaflets long-stalked, usually 5; fleshy root large and spindle-shaped, 10 to 20 cm. long; fruit red, shining *P. quinquefolius*
1. Stem 5 to 20 cm. tall; leaflets sessile, 3 to 5; fleshy root globular, 1 cm. in diameter; fruit yellowish *P. trifolius*

P. quinquefolius L. Ginseng. Rich moist woods; infrequent. Widely distributed, but hardly ever is more than one plant found at a locality. Known from 3 miles north of Castleton; Stuyvesant Falls; 2 miles west of Stuyvesant Falls; Becraft Mountain; Ashley Hill, Chatham; Old Chatham; 2 miles south of Flatbrook; Green River.

P. trifolius L. Dwarf ginseng. Moist woods; frequent, forming small patches. Mount Lebanon, *House 16146;* Austerlitz, *4206* (GA); Niverville, *419;* Stuyvesant Falls, *435;* reported by Stetson (1913) from Copake Falls.

UMBELLIFERAE (Carrot Family)

1. Fruit bearing prickles or bristles, *2*
2. Leaves, at least the lowest, palmately 3- to 7-foliolate; fruit ribless **1. Sanicula**
2. Leaves decompound; fruit ribbed, *3*
3. Involucral bracts cleft or pinnatifid; umbels many-flowered, compact, in fruit suggesting a bird's nest **2. Daucus**
3. Involucral bracts narrow, not cleft or pinnatifid, *4*
4. Fruit 0.5 cm. long or less **3. Torilis**
4. Fruit 1 to 1.5 cm. long **4. Osmorhiza**
1. Fruit neither prickly nor bristly, usually glabrous, *5*
5. Umbels simple, axillary; leaves simple, reniform **12. Hydrocotyle**
5. Umbels compound; leaves, at least in part, compound, *6*
6. Body of fruit strongly dorsally flattened; lateral ribs winged, *7*
7. Flowers yellow **6. Pastinaca**
7. Flowers white, *8*
8. Plants woolly; leaflets up to 15 cm. broad **7. Heracleum**
8. Plants glabrous, or, if tomentose above, the leaflets not more than 2.5 cm. broad, *9*

9. Leaflets incised-cleft, rather finely divided; stylopodium short-conical 8. **Conioselinum**

9. Leaflets coarse, simply or doubly serrate; stylopodium somewhat flattened 9. **Angelica**

6. Body of fruit laterally flattened; ribs not winged, *10*

10. Flowers white, *11*

11. Leaves ternately decompound, only the terminal divisions of the leaf subpinnate; involucre usually none 14. **Cicuta**

11. Leaves pinnate or 3-foliolate, *12*

12. Leaves simply pinnate; involucre and involucels present, conspicuous 13. Sium

12. Leaves 3-divided; involucre and involucels none 5. **Cryptotaenia**

10. Flowers yellow, *13*

13. Leaflets serrate 11. **Zizia**

13. Leaflets entire 10. **Taenidia**

1. **Sanicula** L.

1. Styles recurved, much exceeding the bristles of the fruit, *2*

2. Fruit 6 to 7 mm. long, sessile; sepals of the sterile flowers 1.5 to 2 mm. long *S. marilandica*

2. Fruit 3 to 5 mm. long, somewhat stipitate; sepals of the sterile flowers less than 1 mm. long *S. gregaria*

1. Styles shorter than the bristles of the fruit, *3*

3. Sterile flowers short-pedicelled; fruit subglobose, 3 to 5 mm. long; calyx inconspicuous *S. canadensis*

3. Sterile flowers on long slender pedicels; fruit ovoid, 5 to 8 mm. long, tipped by the conspicuous beaklike calyx *S. trifoliata*

S. marilandica L. Woods; common throughout.

S. gregaria Bickn. Woods; in moist soil. Frequent in the Hudson Valley, unknown elsewhere. Three miles north of Nassau, *House 21769;* 2 miles northwest of Kinderhook, *1831;* Hudson, *House 20498;* Tivoli, *2694.*

S. canadensis L. Woods; in moist soil; common in the Hudson Valley and occurring in the Harlem Valley. Unknown northeastward.

The fourth species included in the key, **S. trifoliata** Bickn., is known to occur both north and south of our area and in Greene and Ulster Counties, but has not been reported from within the Columbia County area.

2. **Daucus** L.

D. Carota L. Wild carrot, Queen Anne's lace. Fields, meadows and roadsides; a common weed.

3. **Torilis** Adans.

T. japonica (Houtt.) DC. Dry fields and roadsides; occasional. South of Madalin, *2874;* 1 mile west of Ancramdale, *3392.*

4. **Osmorhiza** Raf.

1. Stylopodium and style 0.7 to 1 mm. long; stem and leaves more or less villous-pubescent *O. Claytoni*

1. Stylopodium and style 2 to 4 mm. long; stem and leaves essentially glabrous or rarely hairy *O. longistylis*

O. Claytoni (Michx.) C. B. Clarke. Sweet cicely. Moist rich woods; frequent.

O. longistylis (Torr.) DC. Sweet cicely. Moist rich woods, or often in alluvial soil; rather infrequent, in the Hudson and Harlem Valleys. Waldorf Pond, *3112;* Becraft Mountain, *4357* (GH); east of Crugers' Island, *3244.* Known also from West Ghent, Stuyvesant Falls and Hillsdale.

5. Cryptotaenia DC.

C. canadensis (L.) DC. Honewort. Moist rich woods; common.

6. Pastinaca L.

P. sativa L. Wild parsnip. Meadows and roadsides; common, and locally very abundant; often a troublesome weed.

7. Heracleum L.

H. lanatum Michx. (*H. maximum* of *Gray's Manual*). Alluvial meadow 2.5 miles east of Clermont, along Roeliff Jansen Kill, *4767* (USNA); 2 miles southwest of Chatham Center, along Kline Kill, *5105* (USNA); [north of Stephentown Center, *House 29365*]. Otherwise unknown.

8. Conioselinum Hoffm.

C. chinense (L.) BSP. Swampy woods and shaded places in calcareous marshes; rare. One-half mile northeast of Hillsdale, *3917;* south of Pulvers Corners, *3860.*

9. Angelica L.

1. Umbels, fruit and upper part of plant pubescent; leaflets not more than 2 to 2.5 cm. broad *A. venenosa*

1. Umbels, fruit and whole plant glabrous; leaflets 2.5 cm. broad or more *A. atropurpurea*

A. venenosa (Greenway) Fern. Dry woods, in clay or shale soils; infrequent, but widely distributed. Never abundant. Two miles northwest of Kinderhook, *1833;* 2 miles south of Claverack, *3993;* 2 miles southeast of Churchtown, *3501*; Copake Falls, *Britton et al.* (NY); seen also about 3 miles southeast of Harlemville.

A. atropurpurea L. Wet meadows and open swamps; locally very conspicuous and abundant, especially in the lowlands bordering the larger streams. New Lebanon, *House 21310;* Kinderhook, *978.* Seen at Mount Riga Station, town of Northeast; Stuyvesant, Hudson and Germantown, according to House (verbal reports); Pine Plains, where common, according to Hoysradt.

10. Taenidia Drude

T. integerrima (L.) Drude. Dry clay and shale hillsides and bluffs; common in the Hudson Valley, especially near the river; occurs in the Harlem Valley. Waldorf Pond, *3111;* 1 mile east of Kinderhook, *4404* (GH, GA); Nutten Hook, *530;* Alvords' Dock, Stockport, *762;* Robinson Pond, *3924.*

11. Zizia W. D. J. Koch

1. Basal leaves twice or thrice ternate; leaflets ovate to lanceolate, acuminate *Z. aurea*

1. Basal leaves unlobed, cordate, often suborbicular *Z. aptera*

Z. aurea (L.) W. D. J. Koch. Meadow parsnip. Moist meadows and along streams; common throughout.

Z. **aptera** (Gray) Fern. Heart-leaved Alexanders. Rich, often calcareous woods, in rather dry soil; rather frequent in the Hudson and Harlem Valleys. Columbiaville, *3724;* 2 miles south of Claverack, *3991;* 2 miles east of Greendale, *4334;* 1 mile south of Madalin, *2668;* 3 miles north of Ancramdale, *3339;* Copake Falls, *Britton et al.* (NY).

12. Hydrocotyle L.

H. americana L. Pennywort. Moist low grounds and springy places; common throughout.

13. Sium L.

S. suave Walt. Water parsnip. Muddy borders of streams and ponds; common. Most abundant in marshes along the Hudson River.

14. Cicuta L.

1. Leaflets lanceolate; fruit 3 to 3.5 mm. long *C. maculata*
1. Leaflets narrowly linear; fruit less than 2 mm. long; plant with bulblets in upper leaf axils in autumn *C. bulbifera*

C. maculata L. "Water hemlock." Open swamps and margins of streams; common in the Hudson and Harlem Valleys; not reported northeastward.

C. bulbifera L. Swamps and wet places; common.

CORNACEAE (Dogwood Family)

1. Flowers 4-parted, perfect 1. **Cornus**
1. Flowers 5-parted, perfect or unisexual 2. **Nyssa**

1. Cornus L.

1. Flowers in a close cluster, surrounded by a 4-leaved white or pink petal-like involucre, *2*
  2. Plant a small tree; leaves opposite *C. florida*
  2. Plant low, semiherbaceous, with creeping rootstock and short, erect branches; upper leaves crowded, apparently whorled in 4's or 6's *C. canadensis*
1. Flowers in open cymes without an involucre, *3*
  3. Leaves opposite; plants shrubby, erect, *4*
    4. Leaves round-oval or suborbicular, woolly beneath; branchlets green, flecked or streaked with purple *C. rugosa*
    4. Leaves lanceolate to elliptic or ovate, glabrous beneath or pubescent only when young; branchlets red to gray, not normally streaked or flecked, *5*
      5. Branchlets reddish to bright purple-red or purplish, *6*
        6. Branchlets loosely silky-downy, often rusty; pith brownish; fruit pale blue *C. Amomum*
        6 Branchlets glabrous or with scanty straight appressed pubescence; pith white; fruit white or lead-colored *C. stolonifera*
      5. Branchlets gray, smooth; fruit white, on bright red pedicels; cymes very convex or panicled *C. racemosa*
  3. Leaves alternate, clustered near the ends of the branches; fruit deep blue; plant a small tree *C. alternifolia*

C. rugosa Lam. Dry rocky hillsides and bluffs; frequent. Well known on the clays and shales near the Hudson River; known also on calcareous bluffs, as at Old Chatham and at Croghan Mill; less abundant on schistose rocks.

C. Amomum Mill. Silky dogwood. Open swamps, margins of lakes and streams; common.

C. stolonifera Michx. Red-twig dogwood, red osier. Open swampy places; common. Rarely in drier situations.

C. racemosa Lam. Gray-twig dogwood. Dry woods and fields, and especially along fence rows; common.

C. alternifolia L. f. Woods, or occasionally in fields and fence rows; frequent, but almost always solitary.

C. florida L. Flowering dogwood. Woods, or occasionally in fields and fence rows; common in the Hudson and Harlem Valleys. Rare or infrequent eastward and northeastward.

C. canadensis L. Dwarf dogwood, bunchberry. Rocky uplands in acid soil; also in wooded sphagnum bogs; frequent eastward and northward, at elevations of 300 m. or more. Otherwise unknown, except in a moist woods 1 mile north of Kinderhook, *154* (PENN). Known from Stephentown Center; Canticoke Swamp; Berry Pond, Hancock; New Britain; Canaan Center; 1 mile east of Austerlitz; Bashbish Mountain; Mount Alander; Mount Riga, Northeast; Mount Everett; Brace Mountain.

2. Nyssa[1] L.

N. sylvatica Marsh. Black gum. Swamps and wet woods; frequent and locally abundant in the Hudson Valley, especially southward. Unknown from the eastern tier of towns. South of Niverville, *731*; West Ghent, *1121*; 2 miles south of Claverack, *3987;* Rogers Island, *2563;* Crugers' Island, *2946;* summit of Stissing Mountain, *2835*.

ERICACEAE[2] (Heath Family)

1. Ovary superior, *2*
  2. Plants saprophytic, lacking green coloring; pollen grains simple — 1. Subfamily **Monotropoideae**
  2. Plants green; pollen grains compound, *3*
    3. Corolla polypetalous; anthers inverted in the flower; low evergreen herbs — 2. Subfamily **Pyroloideae**
    3. Corolla gamopetalous (rarely polypetalous); anthers erect; habit of plants various — 3. Subfamily **Ericoideae**
1. Ovary inferior; pollen grains compound; corolla gamopetalous — 4. Subfamily **Vaccinioideae**

1. Subfamily MONOTROPOIDEAE

1. Corolla of separate narrow petals — 1. **Monotropa**
1. Corolla gamopetalous, 5-toothed — 2. **Pterospora**

2. Subfamily PYROLOIDEAE

1. Plants with leafy stems; style very short and top-shaped — 5. **Chimaphila**
1. Plants nearly acaulescent, the leaves clustered near base; style elongated, mostly exserted, *2*
  2. Flowers racemose; valves of the capsule with cobwebby margins — 3. **Pyrola**
  2. Flower solitary; valves of capsule with smooth margins — 4. **Moneses**

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[1] This genus is frequently separated as an independent family, *Nyssaceae*, as in *Gray's Manual*.

[2] The first two subfamilies are frequently placed in a separate family, *Pyrolaceae*, as in *Gray's Manual*.

3. Subfamily ERICOIDEAE

1. Fruit a septicidal capsule; corolla in outline funnel-form or saucer-shaped, *2*
  2. Leaves rusty-woolly beneath; flowers white, polypetalous 6. **Ledum**
  2. Leaves not woolly; flowers gamopetalous, *3*
    3. Corolla regular, with pockets in which the anthers are inserted 8. **Kalmia**
    3. Corolla somewhat irregular, without staminal pockets 7. **Rhododendron**
1. Fruit a loculicidal capsule or a berry; corolla urceolate or salver-form, *4*
  4. Corolla salver-form; anthers longitudinally dehiscent; trailing semi-woody herb with oval evergreen leaves 12. **Epigaea**
  4. Corolla urceolate; anthers with terminal pores, *5*
    5. Erect shrubs, rarely less than 30 cm. high; fruit a capsule, *6*
      6. Calyx of imbricated sepals, bibracteate; flowers in leafy-bracted terminal racemes 9. **Chamaedaphne**
      6. Calyx of valvate sepals, naked; flower-bracts not leafy, *7*
        7. Anthers awned on the back; leaves evergreen, white-glaucous beneath 10. **Andromeda**
        7. Anthers naked on the back; leaves deciduous, green 11. **Lyonia**
    5. Plants prostrate or erect, rarely more than 15 cm. high, woody or semiherbaceous; fruit berrylike, *8*
      8. Tough trailing shrubs with scattered leaves 14. **Arctostaphylos**
      8. Aerial stems erect, semiherbaceous, 3 to 15 cm. high, the leaves clustered near the ends of the stems 13. **Gaultheria**

4. Subfamily VACCINIOIDEAE

1. Ovary half-inferior; fruit white when ripe; anther-cells not prolonged into tubes 17. **Chiogenes**
1. Ovary wholly inferior; fruit red, blue or black when ripe; each anther-cell prolonged into a tube, *2*
  2. Leaves resinous-dotted; ovary 10-locular 15. **Gaylussacia**
  2. Leaves not resinous-dotted; ovary 4- to 5-locular, many-seeded 16. **Vaccinium**

1. Monotropa L.

1. Flowers solitary; plants pure white when fresh, turning black when dry *M. uniflora*
1. Flowers racemose; plants light yellowish brown to rose-colored *M. Hypopithys*

M. uniflora L. Indian pipe. In woods, especially where leaf mold is abundant; common, usually in small patches.

M. Hypopithys L. Rich woods, in leaf mold; rare. 3 miles east of Stuyvesant, *1932;* north of Robinson Pond, *3945;* west side of Douglas Knob, New Lebanon, *3623.* All the plants seen are the hairy extreme designated as *M. lanuginosa* Michx. A pink form has also been collected at Robinson Pond, *3926.*

2. Pterospora Nutt.

P. andromedea Nutt. Pine drops. This species is unknown in our area at present, but was reported by Stebbins (1830) from Hudson (as *Monotropa procera*). As suggested by House (1924), the numerous reports of this species in early days would seem to indicate that it was once rather frequent in eastern New York.

3. Pyrola L.

1. Style strongly bent downward, the apex curved upward; racemes not secund, *2*
  2. Leaf blades elliptical or somewhat obovate, thin and dull; calyx-lobes very short, ovate-triangular *P. elliptica*
  2. Leaf blades orbicular, thick, tending to be glossy, *3*
    3. Leaf blades 1 to 2.5 cm. wide; raceme few-flowered; flowers greenish white *P. virens*
    3. Leaves broader, 2.5 to 5 cm. wide; raceme elongated, many-flowered; flowers white *P. rotundifolia*
1. Style straight, not bent downward; raceme dense and spikelike, the flowers all turned to one side *P. secunda*

P. elliptica Nutt. Dry woods, usually in acid soil; common in the eastern tier of towns; decreasing westward and infrequent in the Hudson Valley.

P. virens Schweigger. Dry woods; rare. Canaan Center, *2319*; 2 miles south of Canaan, *3591.* Reported from Stissing Mountain by Hoysradt. Represented in our area by forma **paucifolia** (Fern.) Fern.

P. rotundifolia L. Dry woods, in acid soil; frequent eastward, but infrequent or rare in the Hudson Valley, where suitable habitats are scarce. Known from North Chatham; West Ghent; Claverack; south of Taghkanic Lake; many stations eastward. Represented in our area by var. **americana** (Sweet) Fern.

P. secunda L. Dry woods, in acid soil; rare. Canticoke Swamp, *1710* (PENN); west side of Douglas Knob, New Lebanon, *3624;* east of North Chatham, *4007.*

4. Moneses Salisb.

M. uniflora (L.) Gray. Dry woods, in acid soil; rare. Known only from the west side of Douglas Knob, New Lebanon, *3621;* [Perry Peak, *Mrs. E. S. Deevey* in 1944].

5. Chimaphila Pursh

1. Leaves green throughout, oblanceolate *C. umbellata*
1. Leaves variegated with white along the veins, oblong-lanceolate or lanceolate *C. maculata*

C. umbellata (L.) Bart. Pipsissewa. Dry woods, usually in acid soil; frequent eastward and decreasing westward into the Hudson Valley, where infrequent. Represented in our area only by var. **cisatlantica** Blake.

C. maculata (L.) Pursh. Spotted wintergreen. Dry woods; rare. North of Robinson Pond, *3925;* Tivoli, *2699;* "very scarce" at Pine Plains, according to Hoysradt.

6. Ledum L.

L. groenlandicum Oeder. Labrador tea. Sphagnous woods; rare. Lebanon Springs, *2401;* Pine Plains, *Hoysradt* (NY). I have been unable to relocate the Hoysradt locality.

7. Rhododendron L.

1. Flowers pink or rose-colored, appearing before or with the leaves (May–June) *R. nudiflorum*
1. Flowers white (rarely pinkish), appearing after the leaves are grown (June–July) *R. viscosum*

R. nudiflorum (L.) Torr. (incl. *R. roseum* of *Gray's Manual*). Pinkster, wild azalea. Woods and rocky uplands; common. Throughout, but most abundant in acid soil and so occurring rather sparingly in the Hudson Valley. Eastward this plant may be the most abundant shrub in rocky abandoned pastureland.

R. viscosum (L.) Torr. White azalea. Acid bogs, where abundant, including var. **glaucum** (Lam.) Torr. Bog southeast of Knickerbocker Lake, *1015;* North Chatham, *1035;* [New Britain, *House 23620*]; pond south of Taghkanic Lake, *1235;* bog 2 miles south of Copake Lake, *2601;* 3 miles north of Ancramdale, *3902;* Stissing Mountain, *2833.*

8. Kalmia L.

1. Leaves mostly alternate, bright green on both sides, 5 to 12 cm. long; flowers pale pink to white *K. latifolia*
1. Leaves opposite or in 3's, pale green to white beneath; flowers crimson to rose-purple, *2*
  2. Leaves pale green beneath, flat; inflorescence lateral (appearing later than the new shoots of the season), glandular *K. angustifolia*
  2. Leaves very white-glaucous beneath, the margins strongly revolute; inflorescence terminal, glabrous *K. polifolia*

K. latifolia L. Mountain laurel. Woods and upland pastures and hillsides; in acid soil; common eastward. Unknown from the Hudson Valley, although reported by Woodworth (1840) from Kinderhook, and by Stebbins (1830) from Hudson.

K. angustifolia L. Sheep laurel. Acid bogs and swampy woods; rather frequent. In the Hudson Valley local and not abundant; Niverville; North Chatham; near Knickerbocker Lake; 2 miles south of Claverack.

K. polifolia Wang. Swamp laurel. Acid bogs; rare. 3 miles southeast of Harlemville, *1135;* bog southeast of Knickerbocker Lake, *1013;* seen also at "Fingar Marsh," 2 miles south of Taghkanic Lake.

9. Chamaedaphne Moench

C. calyculata (L.) Moench. Leatherleaf. Acid bogs and borders of ponds; abundant in suitable situations. Rare in the Hudson Valley. Known from Lebanon Springs; 2 miles south of Copake Lake; Mud Pond, Gallatin; Fowlers' Lake; Niverville.

10. Andromeda L.

A. glaucophylla Link. Bog rosemary. Acid bogs; rare, but locally abundant. Taplins' Pond, *2416;* bog southeast of Knickerbocker Lake, *1019;* known also from a bog south of Niverville and from the "Fingar Marsh," Gallatin.

11. Lyonia Nutt.

L. ligustrina (L.) DC. Bogs, wet woods and rocky uplands; frequent eastward. Unknown from the towns along the Hudson River. West of Post Road School, Kinderhook, *158* (PENN); Fowlers' Lake, *266;* West Ghent, *1118;* Stissing Mountain, *2834;* New Lebanon, *House 21313.*

12. Epigaea L.

E. repens L. Mayflower, trailing arbutus. Dry acid soil in woods; common eastward. Rare in the Hudson Valley; in the towns on the Hudson River known only from a bluff at Poelsburg.

13. Gaultheria L.

G. procumbens L. Wintergreen. Dry woods, mostly in acid soil; common eastward. In the Hudson Valley infrequent or rare, occurring on the sandy soils in the town of Kinderhook and probably elsewhere.

14. Arctostaphylos Adans.

A. Uva-ursi (L.) Spreng. Bearberry. Bare rocky summits above 450 m. elevation, on schistose or quartzitic rocks, in the towns of Copake and Ancram and extending eastward and southeastward into Massachusetts and Connecticut; rather local on all the peaks in this limited area, occurring in large patches. Mount Fray, *2641;* Washburn Mountain, *4216* (GH, GA); Mount Alander, *1763;* 1 mile east of Boston Corners, *2270;* [Brace Mountain, *House 24801*]. Our plant is apparently var. **coactilis** Fern. & Macbr.

15. Gaylussacia HBK.

G. baccata (Wang.) K. Koch. Black huckleberry. Dry woods and upland fields, or in bogs; usually in acid soil. Common eastward, but infrequent or rare in the Hudson Valley. A few stations are known in the towns of Ghent and Livingston, as well as several in the sandy soils and in bogs of the town of Kinderhook. This is one of the true huckleberries; the species of the genus *Vaccinium* should properly be known as blueberries.

16. Vaccinium L.

1. Upright shrubs with deciduous leaves; corolla 5-lobed; fruit greenish or blue-black, *2*
- *2.* Corolla open bell-shaped, deeply 5-lobed; anthers 2-awned on the back; berry greenish *V. stamineum*
- *2.* Corolla cylindric or contracted just below the mouth (urceolate), 5-toothed; anthers awnless; berry blue-black, *3*
  - *3.* Low shrubs, mostly less than 1 m. high; corolla mostly 4 to 7 mm. long; plants normally of dry upland soils, *4*
    - *4.* Branchlets and both sides of leaves downy-pubescent *V. myrtilloides*
    - *4.* Branchlets pubescent in lines only; leaves glabrous or somewhat pubescent on the midribs beneath, *5*
      - *5.* Leaf blade elliptic-lanceolate, acute at base and apex, green on both sides, finely toothed along the margin *V. angustifolium*
      - *5.* Leaf blade obovate or oval, glaucous at least beneath, entire or minutely ciliate-serrulate along the margins *V. vacillans*
  - *3.* Tall shrubs 1 to 4 m. high; corolla mostly 6 to 10 mm. long; plants of swampy places, rarely in dry soil, *6*
    - *6.* Leaves glabrous or somewhat pubescent beneath; berries blue to blue-black or quite black, with a waxy bloom *V. corymbosum*
    - *6.* Leaves densely pubescent beneath; berries polished black, without bloom *V. atrococcum*

1. Stem very slender, creeping or trailing; leaves small, entire, whitened beneath, evergreen; corolla deeply 4-cleft; fruit red, shining, *7*
- *7.* Inflorescence mostly terminal on the plant; pedicels bearing about the middle two colored bracts 1 to 2.5 mm. long *V. Oxycoccos*
- *7.* Inflorescence usually surpassed by a long, leafy shoot; pedicels bearing toward the tip two green, leaflike bracts 4 to 10 mm. long *V. macrocarpon*

V. stamineum L. Squawberry. Dry woods, in sandy or shaly soil; frequent, especially in the Hudson and Harlem Valleys.

V. corymbosum L. Highbush blueberry. Swamps, or less often in upland woods; common eastward. Infrequent in the Hudson Valley, and unknown from the towns bordering the river.

V. myrtilloides Michx. Dry rocky woods; rare. New Lebanon, *House 21308;* Brace Mountain, Northeast, *House 24816.* Well known north of our area.

Figure 20. *Chiogenes hispidula* in a sphagnous woods about 1 mile west of Lebanon Springs. The plant has the aromatic flavor of sweet birch; the berries are pure white and slightly smaller than a cranberry.

Figure 21. The starflower, *Trientalis borealis*, in a sandy woodland just north of Kinderhook

V. angustifolium Ait. Lowbush blueberry. Dry woods, banks, and rocky uplands; common. The most abundant species of *Vaccinium* in the eastern part of our area, and the principal source of the "huckleberries" sold commercially.

V. vacillans Torr. Dry sandy or rocky woods, often in acid soil; common.

V. atrococcum (Gray) Heller. Black highbush blueberry. Swamps; infrequent in the southern part of the area. One mile southwest of Clermont, *3259;* south of Mount Riga Station, *3363;* [North Chatham, *Peck*].

V. Oxycoccos L. Small cranberry. Acid bogs; frequent. With the following species, but somewhat more abundant in suitable habitats.

V. macrocarpon Ait. Large cranberry. Acid bogs or boggy depressions in rocky uplands; infrequent. 3 miles southeast of Harlemville, *1130;* 1 mile east of Austerlitz, *293* (PENN); 1 mile south of Taghkanic Lake, *1619* (PENN).

17. Chiogenes Salisb.

C. hispidula (L.) T. & G. Creeping snowberry. Sphagnous woods; rare. Locally abundant near the northern limits of our area, near the southern edge of the Rensselaer Plateau. Lebanon Springs, *3674;* reported from Pine Plains by Hoysradt (1875-79) (figure 20). This is now frequently treated as a species of *Gaultheria,* as in *Gray's Manual.*

PRIMULACEAE (Primrose Family)

1. Capsule opening by a lid; low spreading annual herb, with solitary, axillary scarlet or white flowers; petals obovate, obtuse — 3. **Anagallis**

1. Capsule splitting vertically, not with a lid; flowers yellow or white, *2*

  2. Flowers white, apparently terminal, borne with a whorl of leaves at the summit of the stem; petals finely pointed — 2. **Trientalis**

  2. Flowers yellow, often marked with red or purple — 1. **Lysimachia**

1. Lysimachia L.

1. Leaves dotted; corolla twisted (convolute) in bud; anthers oblong or oval; appendages between the fertile stamens none, *2*

  2. Flowers solitary in the axils of ordinary foliage leaves, *3*

    3. Plants erect, 30 to 90 cm. high, the lanceolate to ovate leaves whorled in 4's or 5's; flowers on long capillary pedicels from the axils; corolla with dark spots or streaks — *L. quadrifolia*

    3. Plant creeping; leaves opposite, roundish-ovate; corolla not dark-spotted or streaked — *L. Nummularia*

  2. Flowers in axillary or terminal spikes or racemes, *4*

    4. Flowers in dense axillary spikes — *L. thyrsiflora*

    4. Flowers in a small-bracted terminal raceme — *L. terrestris*

1. Leaves not dotted; each lobe of corolla wrapped around its stamen in the bud; anthers linear; flowers bearing five slender appendages alternating with the fertile stamens — *L. ciliata*

L. quadrifolia L. Whorled loosestrife. Woods and fields, usually in dry soil; common.

L. terrestris (L.) BSP. Swamp loosestrife. Wet places, in various soils, often along shores; frequent.

L. Nummularia L. Moneywort. Near dwellings and in moist situations; weedy. Frequently established and sometimes very abundant.

L. thyrsiflora L. Tufted loosestrife. Swamps and borders of ponds; infrequent. Widely distributed and locally abundant. New Britain, *3639;* Canaan Center, *1052;* Shaver Pond, *838;* Kinderhook, *958;* Nutten Hook, *863;* Ancram, *808.*

L. ciliata L. Fringed loosestrife. Moist meadows, thickets and along streams; common.

2. Trientalis L.

T. borealis Raf. Starflower. Dry woods, or in sphagnum bogs, usually in acid soil; common eastward. Infrequent in the Hudson Valley, where known from several localities in the town of Kinderhook, and in Claverack (figure 21).

3. Anagallis L.

A. arvensis L. Scarlet pimpernel. Fields and waste grounds; occasionally established as a weed in the Hudson Valley. Known from near Fowlers' Lake; Hudson; Mount Merino; near mouth of Roeliff Jansen Kill, Germantown.

OLEACEAE (Olive Family)

1. Trees with pinnate leaves and dry winged fruits (samaras) **1. Fraxinus**
1. Shrubs with simple leaves; fruit a small fleshy drupe **2. Ligustrum**

1. Fraxinus L.

1. Lateral leaflets nearly or quite sessile, 7 to 11 in number *F. nigra*
1. Lateral leaflets short-stalked, 5 to 9 in number, *2*
  2. Body of fruit terete, the wing terminal and not extending down the sides; whole plant glabrous *F. americana*
  2. Body of fruit partially winged along the sides and gradually dilating into the wing; branchlets and petioles velvety-pubescent *F. pennsylvanica*

F. americana L. White ash. Upland woods, or sometimes in wet places; common. Abundant throughout.

F. pennsylvanica Marsh. Red ash. Swampy woods, stream banks and borders of ponds; common along the Hudson River and decreasing eastward. Known to occur in the Harlem Valley, at Mount Riga Station, Northeast. Unknown northeastward.

F. nigra Marsh. Black ash. Swampy woods, frequent. Throughout, but restricted to permanently wet places, and nowhere very abundant.

2. Ligustrum L.

L. vulgare L. Privet. Persistent or sometimes spreading in old yards or about the sites of former dwellings; infrequent. **Syringa vulgaris** L., the lilac, is also seen occasionally about old dwelling sites where it shows considerable tendency to spread and persist.

GENTIANACEAE (Gentian Family)

1. Leaves opposite, simple, entire, sessile, *2*
  2. Stems very slender and delicate, almost threadlike; leaves scalelike, awl-shaped; flowers white, very small, 3 to 4 mm. long **2. Bartonia**
  2. Stems coarser, not threadlike; leaves flat, green, not scalelike; flowers blue or purple, large, never less than 1 cm. long **1. Gentiana**
1. Leaves alternate, long-petioled, *3*
  3. Leaves trifoliolate; flowers in a raceme on a naked scape; corolla bearded inside **3. Menyanthes**
  3. Leaves simple, rounded, at least some of them floating; flowers in umbels near the summit of the petiole; corolla not bearded inside, or bearded on the margins only **4. Nymphoides**

1. Gentiana L.

1. Corolla lobes conspicuously fringed on margins; flowers about 5 cm. long, solitary at the ends of the peduncles *G. crinita*
1. Corolla lobes not fringed on the margin, 2
   2. Corolla 1 to 2 cm. long, the lobes entire, acute, without folds between them; flowers in clusters of 3 to 7 at the ends of the branches, and also axillary *G. quinquefolia*
   2. Corolla mostly 2 to 5 cm. long, with folds (plaits) between the lobes, 3
      3. Lobes of the corolla broad, rounded, 2 to 8 mm. long, as broad as or broader than the intervening 2- or 3-cleft plaits; margins of the plaits entire or nearly so *G. clausa*
      3. Lobes of the corolla nearly obsolete, narrow, narrower than the intervening plaits which are minutely fimbriate-dentate on the margins *G. Andrewsii*

G. crinita Froel. Fringed gentian. Wet springy hillsides and meadows, usually in calcareous soil; rare, but locally abundant. Definitely known from Kinderhook, Claverack and Ancram, and said to grow in Canaan and New Lebanon. Hoysradt considered it "common" at Pine Plains, probably because of the several calcareous marshes in the vicinity.

G. quinquefolia L. Rocky upland woods; frequent in the eastern tier of towns and decreasing westward. Rare in the Hudson Valley, where it occurs along the Hudson River near Columbiaville, *4037*.

G. Andrewsii Griseb. Closed gentian. Moist soil in thickets and pastures and along streams; locally abundant along the Hudson River and in the adjacent valley; not reported eastward. Wet banks along the river, Poelsburg, *2375;* Waldorf Pond, *House 20919;* pastures northeast of Claverack, *3014;* mouth of Stony Creek, Red Hook, according to Svenson (1935). In the eastern part of our area replaced by the next species.

G. clausa Raf. Borders of ponds and along streams, and often in woods, in sandy or clay soil; frequent or common eastward, at the higher elevations, but rare or absent in the Hudson Valley. 4 miles north of Lebanon Springs, *2409;* Stephentown Center, *House 22349;* No Bottom Pond, *4524;* Robinson Pond, *3954;* 2 miles east of Chatham Center, *3825*.

2. Bartonia Muhl.

B. virginica (L.) BSP. Bogs, usually in sphagnum; frequent. Perhaps more abundant than it seems, as it is inconspicuous. 1 mile north of Kinderhook, *4537;* bog southeast of Knickerbocker Lake, *1755;* Fowlers' Lake, *1672;* Canaan Center, *2323* (PENN); 2 miles south of Copake Lake, *3452*. Known also from the "Fingar Marsh," Gallatin, and from New Britain.

3. Menyanthes L.

M. trifoliata L. Buckbean. Bogs and swamps, usually in calcareous situations; abundant in suitable places. Niverville, *568;* bog 1 mile east of Fowlers' Lake, *563;* Rogers Island, *2549;* Mud Pond, Gallatin, *3284;* Miller Pond, Ancram, *3121*. Represented in our area only by var. **minor** Michx.

4. Nymphoides Hill

1. Flowers white; petiole with a cluster of short and spurlike roots near summit, along with flowering umbel *N. cordatum*
1. Flowers yellow; petiole naked *N. peltatum*

N. cordatum (Ell.) Fern. (*N. lacunosum* of *Gray's Manual*). Floating heart. Ponds; rare. Tackawasick Lake, Muenscher & Clausen *4547* (CU); Riga Lake, Litchfield County, Conn. [Observed by House at Pikes' Pond, Rensselaer County].

N. peltatum (Gmel.) Ktze. This species, reported by Muenscher (1935, p. 248) as forming dense beds in the Hudson River between Waterford and North Troy, was found for the first time in our area at Nutten Hook, Sept. 13, 1936, *4512* (See House, Torreya 37: 80-82. 1937).

APOCYNACEAE (Dogbane Family)

1. Trailing evergreen plants with purplish blue flowers **1. Vinca**
1. Upright herbs with pink or white flowers **2. Apocynum**

1. Vinca L.

V. minor L. Periwinkle. Occasionally established and spreading in cemeteries and yards and along roadsides.

2. Apocynum L.

1. Flowers 6 to 9 mm. long; corolla pink *A. androsaemifolium*
1. Flowers 3 to 4.5 mm. long; corolla white *A. cannabinum*

A. androsaemifolium L. Dogbane. Dry fields and thickets; common.

A. cannabinum L. (incl. *A. sibiricum* of *Gray's Manual*). Indian hemp. Gravelly or sandy shores, or as a weed in fields; common. Rather local; most abundant along the larger streams, on gravel banks.

ASCLEPIADACEAE (Milkweed Family)

1. Stems erect, not twining; flowers greenish, white, orange, pink or purple, not dark purplish red; crown of five hooded bodies, these each usually with a sharp incurved horn **1. Asclepias**
1. Stems twining; flowers very dark purplish red; crown flat, simple **2. Cynanchum**

1. Asclepias L. Milkweed

1. Sharp incurved horns of the crown wanting *A. viridiflora*
1. Horns present, *2*
  2. Flowers orange; leaves mostly alternate *A. tuberosa*
  2. Flowers white, pink or purple; leaves opposite or whorled, *3*
    3. Leaves linear, in whorls of 3 to 7; corolla greenish white *A. verticillata*
    3. Leaves lanceolate or broader, *4*
      4. Pods pubescent, covered with soft spines; plant stout, finely soft-pubescent; corolla lobes dull purple to white, 6 to 9 mm. long *A. syriaca*
      4. Pods essentially glabrous, smooth and spineless; plants mostly glabrous, *5*
        5. Leaves thick, sessile, cordate-clasping at base, obtuse and mucronulate at apex, wavy or crinkly-margined; umbel solitary, terminal; corolla greenish purple *A. amplexicaulis*
        5. Leaves narrowed or rounded at base, petiolate, the petiole mostly 6 to 30 mm. long; umbels 1 to many, *6*
          6. Middle leaves whorled in 4's, the others opposite; corolla pink or nearly white, its lobes 4 to 6 mm. long; hood white; flowering in May and June *A. quadrifolia*

6. Leaves all opposite, *7*
7. Leaves lanceolate; corolla red or rose-purple; hoods pink or purplish; corolla lobes about 4 mm. long *A. incarnata*
7. Leaves ovate or oblong; corolla and hoods greenish white or pale purplish; corolla lobes 6 to 8 mm. long *A. exaltata*

A. tuberosa L. Butterflyweed. Dry sandy or shaly soil; infrequent, and sometimes appearing as if adventive. Near Canticoke Swamp, *1699;* Old Chatham, on a railroad embankment, *1399;* [Claverack, *Rev. A. P. Van Gieson* in 1869 (V)]; seen also at Alvords' Dock, Stockport, and near Fowlers' Lake.

A. incarnata L. Swamp milkweed. Swamps and wet grounds; frequent.

A. amplexicaulis Sm. Sandy fields; rare. North Chatham, *House 21555;* Kinderhook, *1067.*

A. exaltata L. Poke milkweed. Dry or moist woods; infrequent or rare in the Hudson Valley; somewhat more frequent eastward. 1 mile north of Riders Mills, *1260;* North Chatham, *House 21547;* 2 miles east of Austerlitz, *2283;* 1 mile south of Taghkanic Lake, *1234.*

A. quadrifolia Jacq. Dry woods and thickets; frequent, especially in calcareous regions. Brainard, *House 21384;* 3 miles south of Kinderhook, *192* (PENN); Stuyvesant Falls, *Iva Allen;* Alvords' Dock, Stockport, *773;* Nutten Hook, *860;* 1.5 miles east of Clermont, *3234;* Washburn Mountain, Copake, *3465;* 3 miles north of Ancramdale, *802.*

A. syriaca L. Common field milkweed. Fields, pastures and along streams; common, often a weed.

A. verticillata L. Dry shaly hillsides; infrequent, in the Hudson Valley from Becraft Mountain southward. Becraft Mountain, *2422* (PENN); Blue Hill, *2161;* 1 mile south of Germantown, *3320.* Reported from the summit of Little Stissing Mountain by Hoysradt (1875-79).

A. viridiflora Raf. Green milkweed. Known only from dry shaly slopes, eastern base of Blue Hill, Livingston, *2187.*

2. Cynanchum L.

C. nigrum (L) Pers. Roadsides and woods near dwellings; occasional. Seen at Stockport and at Nutten Hook.

CONVOLVULACEAE (Morning-glory Family)

1. Leafless parasitic twining herbs lacking green coloration, the stems yellow or orange 1. **Cuscuta**
1. Erect or twining herbs with green stems and leaves and large pink or white funnel-shaped flowers 2. **Convolvulus**

1. Cuscuta L.

1. Stigmas capitate; perianth segments obtusely rounded. *C. Gronovii*
1. Stigmas linear; perianth segments acute *C. Epithymum*

C. Gronovii Willd. Dodder, love-vine. Parasitic on various herbs and shrubs, often forming dense tangled masses; common, throughout. New Lebanon, *Harrison;* Boston Corners, *4473;* Kinderhook Lake, *House 18853;* Schodack Island, *House 24199;* flats between Hudson and Athens, *Muenscher & Clausen* 4707 (CU); North Bay, Tivoli, *2771.*

C. Epithymum Murr. European dodder. Found once in our area, on a leguminous host, at Ghent, *V. D. Waterman.*

2. Convolvulus L.

1. Calyx inclosed in two broad leafy bracts; stigmas oval or oblong, *2*
2. Stem low, erect (or the tips sprawling); petiole not more than one-fourth as long as leaf blade; bracts narrowed at base *C. spithamaeus*
2. Stem long-twining or trailing; petioles longer; bracts broad and usually cordate at base *C. Sepium*
1. Calyx bractless at base; stigmas filiform *C. arvensis*

C. spithamaeus L. Dry sandy or shaly fields and hillsides; infrequent. Brainard, *House 21351;* Kinderhook Lake, *903;* Stuyvesant Falls, *Iva Allen;* 3 miles north of Ancramdale, *1083* (PENN).

C. Sepium L. Bindweed. Woods, thickets and cultivated ground; common, often a troublesome weed.

C. arvensis L. Bindweed. Dry fields and roadsides; an introduced species locally established as a weed.

POLEMONIACEAE (Phlox Family)

Phlox L.

1. Plants tall, often 50 to 150 cm. high; leaves broad, oblong or ovate-lanceolate *P. paniculata*
1. Plants tufted, creeping; leaves awl-shaped or narrowly linear *P. subulata*

P. paniculata L. Garden phlox. Occasionally established; 1 mile east of Pulvers Station, Ghent; ½ mile south of Madalin, *2869.* Both of the above stations are in woods, and the plants apparently not introduced, but Dr. E. T. Wherry, who is an authority on the genus *Phlox,* considers the species not to be indigenous at either locality.

P. subulata L. "Moss pink," moss phlox. Cemeteries and yards; occasionally well established (as a clone).

HYDROPHYLLACEAE (Waterleaf Family)

Hydrophyllum L.

1. Cauline leaves pinnately parted or divided *H. virginianum*
1. Cauline leaves orbicular to reniform, palmately lobed or divided *H. canadense*

H. virginianum L. Waterleaf. Rich moist woods, usually in somewhat calcareous soil, in the eastern part of our area; infrequent. Unknown to me from the Hudson Valley. West of Berry Pond, *3779;* No Bottom Pond, *1940;* 2 miles south of Flatbrook, *3607;* Brainard, *House 21343;* gorge of Bashbish Brook, Copake, *3567;* [Claverack, *Rev. A. P. Van Gieson* in 1869 (V)].

[**H. canadense** L. Claverack, *Rev. A. P. Van Gieson* in 1869 (V). Determination by House]. A rare plant in eastern New York, and unknown from our area except from this specimen.

BORAGINACEAE (Borage Family)

1. Flowers irregular, blue, showy; plant upright, coarse and weedy, rough-hirsute 6. **Echium**
1. Flowers regular, *2*
2. Nutlets armed with barbed prickles, *3*
3. Nutlets flattened, spreading, covered with prickles 1. **Cynoglossum**
3. Nutlets erect, with prickles on the margins or on the back, *4*
4. Pedicels recurved or reflexed in fruit; style shorter than the nutlets; plants biennial or perennial 3. **Hackelia**
4. Pedicels erect; style longer than the nutlets; plants annual 2. **Lappula**

2. Nutlets unarmed, *5*
5. Racemes without bracts — 4. **Myosotis**
5. Racemes with bracts at base of pedicels — 5. **Lithospermum**

1. **Cynoglossum** L.

C. officinale L. Hound's tongue. Woods and waste places; occasional. Three miles north of Claverack, *1302.*

2. **Lappula** Moench

L. echinata Gilib. Waste places; occasional. Poelsburg, *2379;* Hudson, *4756* (USNA).

3. **Hackelia** Opiz

H. virginiana (L.) I. M. Johnst. Dry woods; common in the Hudson Valley and decreasing eastward.

4. **Myosotis** L. Forget-me-not

1. Plant bristly-hirsute, with spreading hairs; at least some of the hairs of the calyx minutely hooked; corolla white — *M. verna*
1. Plant appressed-pubescent; calyx hairs all straight; corolla blue, with yellow or white eye, *2*
2. Corolla 5 to 8 mm. broad; calyx lobes shorter than the tube *M. scorpioides*
2. Corolla 2 to 4 mm. broad; calyx lobes as long as the tube or longer — *M. laxa*

M. verna Nutt. Dry shaly hillsides; Blue Hill, Livingston, *601* (PENN), *5032* (USNA).

M. scorpioides L. Along brooks and springy places; occasional. Near Valatie, *1874.*

M. laxa Lehm. Wet places along streams and by ponds; frequent in the Hudson Valley. Decreasing eastward and unknown from the eastern tier of towns. 3 miles north of Castleton; Hotaling Island; Niverville; Brainard; Stuyvesant Falls; Hudson; Rogers Island; Nevis; Silvernails.

5. **Lithospermum** L.

L. officinale L. Dry soil, in waste places; occasional. Hillsdale, *3544.*

6. **Echium** L.

E. vulgare L. Blue devil. Dry fields and waste places; a common weed in the Hudson Valley and adjacent uplands, especially in clay and shaly soils; somewhat less frequent eastward.

VERBENACEAE (Verbena Family)

Verbena L.

1. Leaves narrowly lanceolate, sessile — *V. simplex*
1. Leaves ovate to lanceolate, petioled, *2*
2. Flowers white — *V. urticifolia*
2. Flowers violet-blue — *V. hastata*

V. simplex Lehm. Dry shaly slopes; Becraft Mountain, *2239;* [Pine Plains, *Hoysradt* (GH)]. Appearing as if adventive.

V. urticifolia L. White vervain. Waste places and pastures; common, often weedy.

V. hastata L. Blue vervain. Pastures and wet places; common. Abundant in moist meadows and along streams, but also often weedy, in pastures and cultivated ground.

LABIATAE (Mint Family)

1. Upper lip of corolla apparently none, the lower lip apparently 5-lobed — 1. **Teucrium**
1. Corolla 2-lipped or nearly regular, *2*
  2. Ovary deeply 4-lobed, *3*
    3. Corolla lobes spreading; stamens little exserted — 2. **Isanthus**
    3. Corolla lobes all declined; stamens much exserted — 3. **Trichostema**
  2. Ovary of four distinct or nearly distinct nutlets, *4*
    4. Calyx with a crest or protuberance on the upper side — 4. **Scutellaria**
    4. Calyx without a crest or protuberance, *5*
      5. Corolla strongly 2-lipped; lips unlike, the upper concave and usually arched as seen from the side, *6*
        6. Stamens with anthers 4, *7*
          7. Upper pair of stamens longer than the lower one, *8*
            8. Anthers not approximate in pairs, plainly exserted, the upper ones declined — 5. **Agastache**
            8. Anthers approximate in pairs, scarcely extending beyond the upper lip — 6. **Nepeta**
          7. Upper pair of stamens shorter than the lower pair, *9*
            9. Calyx closed in fruit; bracts large, broad and reniform — 7. **Prunella**
            9. Calyx open in fruit; bracts not as above, *10*
              10. Calyx membranous, inflated in fruit, faintly nerved — 8. **Physostegia**
              10. Calyx not inflated, firmer and strongly nerved, *11*
                11. Calyx teeth rigid and spine-tipped, *12*
                  12. Leaves not lobed, simple and pinnately veined, the margins toothed — 9. **Galeopsis**
                  12. Leaves palmately 3- to 5-lobed or incised, at least the lower ones — 10. **Leonurus**
                11. Calyx teeth not spine-tipped, *13*
                  13. Nutlets sharply 3-angled, truncate at apex; lower lip of corolla sharply constricted at base — 11. **Lamium**
                  13. Nutlets obscurely angled, rounded at apex; lower lip of corolla scarcely constricted — 12. **Stachys**
        6. Stamens with anthers 2 — 13. **Monarda**
      5. Corolla slightly 2-lipped or almost regular; upper lip nearly flat, erect or spreading, not arched, *14*
        14. Flowers in more or less crowded clusters or whorls or axillary, *15*
          15. Corolla more or less 2-lipped, *16*
            16. Stamens with anthers 2 — 14. **Hedeoma**
            16. Stamens with anthers 4, *17*
              17. Stamens curved, often converging or ascending under the upper lip of the corolla — 15. **Satureja**
              17. Stamens straight, often diverging, never converging as above, *18*
                18. Plants tall, erect; calyx nearly regular, *19*
                  19. Clusters of flowers subtended by large colored bracts — 16. **Origanum**

19. Clusters of flowers subtended by inconspicuous greenish bracts **18. Pycnanthemum**
18. Plants low, creeping; calyx 2-lipped **17. Thymus**
15. Corolla regular or essentially so, *20*
20. Stamens with anthers 2 **19. Lycopus**
20. Stamens with anthers 4 **20. Mentha**
14. Flowers in loose leafless panicles, not more than 2 or 3 at a node; stamens 2 **21. Collinsonia**

1. Teucrium L.

T. canadense L. Edges of tidal mud along the Hudson River; there common. Otherwise infrequent, in the Hudson Valley; Kinderhook, *1368;* Waldorf Pond, *House 21754;* [Claverack, *Rev. A. P. Van Gieson* in 1869 (V)].

2. Isanthus Michx.

I. brachiatus (L.) BSP. Dry sandy or shaly hillsides; rare, in the Hudson and Harlem Valleys. Poelsburg, *1822;* Blue Hill, *2163;* Rogers Island, *4462;* 2 miles northwest of Copake Falls, *3587.*

3. Trichostema L.

T. dichotomum L. Blue curls. Dry sandy or gravelly soil; common in the Hudson and Harlem Valleys. Unknown northeastward.

4. Scutellaria L. Skullcap

1. Flowers small, 5 to 8 mm. long, in axillary secund racemes *S. lateriflora*
1. Flowers larger, about 2 cm. long, solitary in the leaf axils *S. epilobiifolia*

S. lateriflora L. Swamps and wet woods; common.

S. epilobiifolia A. Hamilton. Low places, swamps and rarely on moist cliffs; common.

5. Agastache Gronov.

A. scrophulariaefolia (Willd.) Ktze. Pine Plains, *C. H. Peck.* "Rather common" at Pine Plains, according to Hoysradt. Otherwise unknown.

6. Nepeta L.

1. Plant coarse, erect; flowers in rather dense axillary and terminal clusters, whitish, with purple spots; upper floral leaves much reduced *N. Cataria*
1. Plant creeping and trailing; flowers in loosely few-flowered axillary clusters, light blue; leaves all alike *N. hederacea*

N. Cataria L. Catnip. Waste places and woods, usually near dwellings, common.

N. hederacea (L.) Trevisan (*Glechoma hederacea* of *Gray's Manual*). Ground ivy. Moist shady places, especially near dwellings; commonly established and weedy.

7. Prunella L.

P. vulgaris L. Heal-all. Woods and fields; common and weedy. Represented in our area by var. **lanceolata** (Bart.) Fern.

8. Physostegia Benth.

P. virginiana (L.) Benth. Dragon-head. Moist banks near streams; rare, in the Hudson Valley. Perhaps always an escape. 2 miles west of Nevis, *2895;* Stony Creek, near Madalin, *Svenson 6113, 6432* (Svenson, 1935).

9. **Galeopsis** L.

G. Tetrahit L. "Hemp nettle." Fields and roadsides; occasional as a weed. Riders Mills; Chatham; Copake.

10. **Leonurus** L.

L. Cardiaca L. Motherwort. Waste places and in woods; common and weedy.

11. **Lamium** L.

L. amplexicaule L. Henbit. Gardens and moist banks; occasional, weedy.

12. **Stachys** L.

1. Stems glabrous on the sides, the angles beset with long reflexed bristles; leaves, at least the lower, on petioles 7 to 30 mm. long *S. tenuifolia*

1. Stems pubescent uniformly on the sides and on the angles; leaves sessile or the lower with petioles 3 to 6 mm. long *S. palustris*

S. tenuifolia Willd. Edges of tidal mud along the Hudson River; there common. Otherwise very local; Kinderhook Lake, according to House (verbal report); Kinderhook, along creek, *1367;* Brainard, *House 18426.* Represented in our area by var. **platyphylla** Fern.

S. palustris L., var. **homotricha** Fern. A plant collected at Lebanon Springs by *A. K. Harrison,* Aug. 18, 1893, is apparently this variety. This specimen was referred by House (1924) to *S. arenicola* Britton.

13. **Monarda** L.

M. fistulosa L. Wild bergamot. Dry fields, banks and edges of woods; common eastward. In the Hudson Valley infrequent; found mostly on shales, near the river. North Chatham, *House 20467;* Mount Merino, *1097;* Blue Hill, *2423.* In our area the var. **mollis** (L.) Benth. can be recognized only as isolated individuals lacking the long scattered hairs of the typical plant; there appears to be no geographical distinction between the two so-called varieties.

14. **Hedeoma** Pers.

H. pulegioides (L.) Pers. Pennyroyal. Dry woods and in clearings; common throughout.

15. **Satureja** L.

S. vulgaris (L.) Fritsch. Basil. Dry fields and margins of woods; frequent. No Bottom Pond, *1351;* Robinson Pond, *1927* (PENN); Poelsburg, *2254;* Ashley Hill, Chatham, *2205;* Mount Merino, House, *22637;* Clermont, *3226.*

16. **Origanum** L.

O. vulgare L. Wild marjoram. Roadsides and fields; local. Known only from the calcareous regions of the Harlem Valley; 2 miles south of Copake, *3443.* A pest on limestone soil at Pine Plains, according to Hoysradt (1875-79).

17. **Thymus** L.

T. Serpyllum L. Wild thyme. Old fields and roadsides; common on the shales and limestones of New Lebanon and Canaan; unknown elsewhere. Locally very abundant and forming large patches.

18. Pycnanthemum Michx.

1. Leaves ovate-oblong, mostly 1.5 to 4 cm. wide, densely white-hoary beneath *P. incanum*
1. Leaves narrowly lanceolate or linear, not more than 1.3 cm. wide, mostly glabrous, not white-hoary, *2*
2. Leaves linear, the larger 2 to 4 mm. wide; calyx teeth subulate, firm-tipped, evident on the head of flowers *P. tenuifolium*
2. Leaves lanceolate, the larger 6 to 13 mm. wide; calyx teeth short-triangular, obscure, scarcely firm-tipped *P. virginianum*

P. incanum (L.) Michx. Dry shaly hillsides; infrequent. Curtis Mountain, *2145*; Alvords' Dock, Stockport, *2224*; Blue Hill, *2182*; Stissing Mountain, *2863*.

P. tenuifolium Schrad. Fields and meadows, often in dry soil; frequent. Not reported northeastward.

P. virginianum (L.) Durand & Jackson. Meadows and dry banks; frequent. Often with the preceding species but usually less abundant. Not reported from the northeastern part of the area. Kinderhook, *1568, 1783;* Valatie, *1826;* 1 mile southeast of Clermont, *3227;* Forest Lake, *2073;* Copake Falls, *3911.*

19. Lycopus L.

1. Lower leaves incised-pinnatifid; calyx lobes awn-tipped, rigid, longer than the nutlets *L. americanus*
1. Leaves not incised-pinnatifid, the margins merely serrate; calyx lobes deltoid or lanceolate, thin and blunt, not or scarcely exceeding the nutlets, *2*
2. Stems from a slender (not tuberous-thickened) base; flower clusters dense, at maturity 8 to 15 mm. broad *L. virginicus*
2. Stems with tuberous base; flower clusters at maturity usually 4 to 9 mm. broad *L. uniflorus*

L. americanus Muhl. Moist or wet soil; common.

L. virginicus L. Wet places along streams; apparently not frequent. Kinderhook Lake, *House 11304;* 2 miles north of Kinderhook, *1842.*

L. uniflorus Michx. Moist or wet soil; frequent. Stuyvesant Falls, *2031;* Forest Lake, *2075;* 4 miles southeast of Spencertown, *1853;* Copake Falls, *Britton et al.* (NY).

20. Mentha L. Mint

1. Stems pubescent, at least on the angles; leaves green, lanceolate to oblong-lanceolate, acute at base; corolla 4 to 5 mm. long; calyx 2.5 to 3 mm. long, *2*
2. Stems pubescent on the sides; leaves pubescent *M. arvensis* var. *villosa*
2. Stems glabrous on the sides, minutely pubescent on the angles; leaves glabrous *M. arvensis* forma *glabrata*
1. Stems glabrous or rarely with a few scattered hairs; leaves ovate to obovate, often white-blotched; corolla 2 mm. long; calyx 1.7 mm. long *M. gentilis*

M. arvensis L. Wild mint. Wet meadows and banks of streams; common. Mostly represented by var. **villosa** Benth. The less pubescent f. **glabrata** (Benth.) S. R. Stewart is apparently infrequent or rare; No Bottom Pond, *1954;* 2 miles south of Tivoli, *2787.*

M. gentilis L. Along Kinderhook Creek, 2 miles east of Valatie, *1879.* Doubtless introduced elsewhere.

21. Collinsonia L.

C. canadensis L. Stoneroot. Moist rich woods; common.

SOLANACEAE (Nightshade Family)

1. Fruit a berry, *2*
2. Calyx bladdery-inflated in fruit, inclosing the berry 1. Physalis
2. Calyx not inflated in fruit (if inclosing the fruit, the plant prickly), *3*
3. Corolla wheel-shaped; anthers connivent, opening by pores at the tip 2. Solanum
3. Corolla short funnel-form; anthers separate, opening by longitudinal slits 3. Lycium
1. Fruit a prickly capsule; flowers white or purplish, large, 5 to 15 cm. long 4. Datura

1. Physalis L.

1. Plant glandular-pubescent, more or less sticky; berry yellow *P. heterophylla*
1. Plant glabrous or nearly so; berry purple *P. subglabrata*

P. heterophylla Nees. "Ground cherry." Pastures, roadsides and clearings, in dry soil; frequent, but rather local, in the Hudson Valley. Not reported eastward. One mile east of Poelsburg, *1687;* Waldorf Pond, *House 20930;* Becraft Mountain, *2240;* Rhinecliff, *House 19257.*

P. subglabrata Mackenz. & Bush. Dry roadsides or in waste places; occasional along the Hudson River. Stuyvesant, *House 13315.* Also collected by House at New Baltimore, Greene County.

2. Solanum L.

1. Plants with long straggling or climbing stems, woody at base; corolla usually purple; berries bright red, smooth; leaves often with two lobes near base *S. Dulcamara*
1. Plants annual or perennial, erect, not climbing nor straggling; fruits never bright red, *2*
2. Plants not prickly; leaves entire or undulate; corolla white, 3 to 8 mm. broad; berry black *S. nigrum*
2. Plants usually prickly; leaves lobed or pinnatifid; corolla white, lavender or yellow, *3*
3. Corolla lavender or white; berry naked, smooth, orange-yellow *S. carolinense*
3. Corolla yellow; berry wholly inclosed by the spiny calyx *S. rostratum*

S. Dulcamara L. Climbing nightshade. Waste places; common. Also in swamps; this species is found in the deepest swamps, in the most remote parts of our area, and is seemingly absolutely indigenous; it is one of the commonest swamp plants, and abundant everywhere.

S. nigrum L. (incl. *S. americanum* of *Gray's Manual*). Nightshade. Waste places and cultivated grounds; weedy, occasional. Kinderhook; Nutten Hook; Becraft Mountain.

S. carolinense L. "Horse nettle." Cultivated or waste grounds; rare, adventive from farther south. Near mouth of Muitzes Kill, *House 24198.*

S. rostratum Dunal. A western species, found at Philmont in 1927; determined at the New York State Museum. Not seen elsewhere.

Solanum tuberosum L., the potato, and **Lycopersicon esculentum** Mill., the tomato, are often spontaneous about cultivated grounds, but are not persistent.

3. Lycium L.

L. halimifolium Mill. Matrimony vine. Cultivated, and sometimes spreading and long-persistent around dwellings and in waste ground.

4. Datura L.

D. Stramonium L. Jimson weed. Dooryards and in cultivated or waste ground; a common weed.

SCROPHULARIACEAE (Figwort Family)[1]

1. Fertile stamens (those with anthers) 5; corolla nearly regular, rotate — 6. **Verbascum**

1. Fertile stamens 2 or 4, *2*

- *2.* Corolla with a spur on lower side at base, *3*
  - *3.* Flowers solitary in the axils of the upper leaves; plants conspicuously glandular-pubescent — 11. **Chaenorrhinum**
  - *3.* Flowers in terminal racemes; plants glabrous or nearly so — 10. **Linaria**
- *2.* Corolla without a spur, *4*
  - *4.* Fertile stamens 2, *5*
    - *5.* Corolla tubular, evidently 2-lipped; stamens not strongly exserted, *6*
      - *6.* Calyx 5-parted; upper lip of corolla about equaling the lower, *7*
        - *7.* Two sterile filaments slender, elongated, somewhat exserted — 3. **Lindernia**
        - *7.* Sterile filaments minute or none — 1. **Gratiola**
      - *6.* Calyx 4-toothed; upper lip of corolla obsolete, much shorter than the lower — 4. **Hemianthus**
    - *5.* Corolla rotate or, if tubular, the stamens long-exserted, *8*
      - *8.* Corolla rotate; capsule obcordate or emarginate, flattened — 13. **Veronica**
      - *8.* Corolla tubular-funnel-form; capsule ovoid, not flattened — 12. **Veronicastrum**
  - *4.* Fertile stamens 4, *9*
    - *9.* Plants scapose, growing in mud; leaves subulate or threadlike — 5. **Limosella**
    - *9.* Plants with leafy stems, *10*
      - *10.* Flowers with a sterile stamen (without anther) in addition to the 4 fertile stamens, *11*
        - *11.* Flowers greenish yellow to brownish purple; sterile stamen flattened, nearly as wide as or wider than long — 9. **Scrophularia**
        - *11.* Flowers white to pink or purplish; sterile stamen slender, filiform, *12*
          - *12.* Pedicel bibracteolate; inflorescence simple — 7. **Chelone**
          - *12.* Pedicel not bracteolate; inflorescence compound, the flowers in axillary peduncled cymes — 8. **Penstemon**
      - *10.* Flowers lacking a fifth (sterile) stamen, *13*
        - *13.* Corolla 2-lipped, with the throat closed by a prominent palate; calyx prominently 5-angled — 2. **Mimulus**
        - *13.* Throat of corolla not closed by a palate; calyx not angled, *14*
          - *14.* Corolla scarcely or not at all 2-lipped, *15*
            - *15.* Corolla golden yellow — 14. **Aureolaria**
            - *15.* Corolla pink or purplish — 15. **Gerardia**
          - *14.* Corolla strongly 2-lipped, the stamens ascending under the upper lip, *16*
            - *16.* Leaves pinnately lobed; bracts not spiny — 16. **Pedicularis**
            - *16.* Leaves entire; bracts distinctly spiny — 17. **Melampyrum**

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[1] Specimens of Scrophulariaceae, designated by an asterisk (*), have been determined by Dr. Francis W. Pennell of the Academy of Natural Sciences of Philadelphia.

1. **Gratiola** L.

G. neglecta Torr. Wet or muddy places; common.

2. **Mimulus** L.

1. Leaves petioled; stems winged at the angles *M. alatus*
1. Leaves clasping by a cordate base; stem square *M. ringens*

M. alatus Ait. Wet places along streams; infrequent, in the Hudson Valley. Hotaling Island, *Taylor 1391** (NY); Stuyvesant, *1550**; New Forge, along Taghkanic Creek, *3477;* Tivoli, *2937;* 0.5 mile south of Madalin, *2870* (PH).

M. ringens L. Monkey flower. Wet places; common.

3. **Lindernia** All.

1. Pedicels as long as or longer than the subtending bracts, 10 to 20 mm. long, usually divaricately spreading *L. dubia* subsp. *dubia*
1. Pedicels shorter than the bracts, usually less than 10 mm. long, and ascending, *2*
  2. Plant erect, often dwarf; fruiting pedicels 3 to 5 mm. long; leaf blades oval, all broadly rounded or obtuse *L. dubia* var. *inundata*
  2. Plant diffuse; fruiting pedicels at least 5 mm. long; leaf-blades oblanceolate to ovate-lanceolate, usually only the lower ones obtuse or rounded at apex *L. dubia* subsp. *major*

L. dubia (L.) Pennell, ssp. **dubia** (var. *riparia* of *Gray's Manual*). A plant from Niverville, *1798,* is doubtfully referred here. Pennell (1935) cites no material from the lower Hudson Valley.

Ssp. **major** (Pursh) Pennell (typical *L. dubia* of *Gray's Manual*). Wet or muddy places along streams and by ponds; common in the Hudson Valley; unknown eastward. Kinderhook Lake, *House 16786*;* Stuyvesant, *House 13313*;* East Nassau, *House 21938;* Valatie, *1873;* Stuyvesant Falls, *2035;* 2 miles south of Kinderhook, *1245.*

Var. **inundata** (Pennell) Pennell. Tidal mud along the Hudson River; common. Abundant on the mud flats between tide levels. Unknown elsewhere. Hudson, *1611*;* Rogers Island, *3741;* Stony Creek, Madalin, according to Svenson (1935).

4. **Hemianthus** Nutt.

H. micranthemoides Nutt. (*Micranthemum* of *Gray's Manual*). Tidal mud at mouth of Stony Creek, south of Madalin, *Svenson 6109** (PH). An estuarine species which apparently reaches its northern limit at this point.

5. **Limosella** L.

L. subulata Ives. Tidal mud along the Hudson River; rather frequent, but only locally abundant. Poelsburg, *3817;* Little Nutten Hook, *Muenscher & Clausen 4555** (PH, CU); Rogers Island, *4471;* mouth of Stony Creek, Madalin, according to Svenson (1935).

6. **Verbascum** L.

1. Plant densely woolly; flowers nearly sessile, in a dense spike *V. Thapsus*
1. Plant green and smoothish, not woolly; flowers pedicelled, in a loose raceme *V. Blattaria*

V. Thapsus L. Mullein. Fields, roadsides and waste places; a common weed.

V. Blattaria L. Moth mullein. Fields, pastures and roadsides; occasional.

7. **Chelone** L.

C. glabra L. Turtlehead. Wet places in woods and open swampy meadows, often along streams; common.

8. **Penstemon** Mitchell Beard-tongue

1. Plants glabrous or nearly so; corolla tube much inflated, only slightly 2-ridged within; sterile stamen only slightly bearded; corolla lobes all about the same length, *2*

2. Anthers normally somewhat bearded; sepals ovate, acuminate-tipped *P. Digitalis*

2. Anthers glabrous; sepals linear-lanceolate, long-attenuate *P. calycosus*

1. Plants evidently pubescent or hirsute, especially below; corolla tube strongly 2-ridged within; sterile stamen densely bearded; lower lip of corolla projecting considerably beyond the upper, *3*

3. Corolla white, lined with purple; leaves densely and softly pubescent, velvety to the touch *P. pallidus*

3. Corolla tube purple, the lobes white; tube not lined with deeper color; leaf blades early glabrous *P. hirsutus*

P. Digitalis Nutt. Roadsides and fields; occasionally established and locally abundant. 3 miles south of Kinderhook, *1212;* Chatham Center, *1050;* 1 mile west of Ghent, *1000;* Ancramdale, *1084*;* 3 miles east of Germantown, *3156;* [first known collection from our area is Claverack, *Rev. A. P. Van Gieson* in 1871 (V)].

P. calycosus Small. In a field north of Chatham Center, *1055**. Unknown elsewhere.

P. pallidus Small. Dry sandy or shaly fields; occasional, and locally abundant. Brainard, *House 21393;* Niverville, *729;* Kinderhook, *780**; 1 mile east of Pulvers Station, Ghent, *844;* 3 miles north of Ancramdale, *824.*

P. hirsutus (L.) Willd. Dry shaly hillsides and bluffs; frequent in the Hudson Valley. Poelsburg, *885;* 1 mile north of Stuyvesant Falls, *777;* Nutten Hook, *849;* Mount Merino, *1095*;* Blue Hill, *House 22651.*

9. **Scrophularia** L.

1. Corolla 7 to 11 mm. long, lustrous greenish brown; petioles 1 to 3 cm. long; flowering period May to July *S. lanceolata*

1. Corolla 5 to 8 mm. long, dull brown; petioles 3 to 8 mm. long; flowering period July to September *S. marilandica*

S. lanceolata Pursh. Woods and thickets, or in pastures, in rather dry soil; common in the Hudson Valley; occurs in the Harlem Valley; unknown northeastward.

S. marilandica L. Woods and pastures, in rich or moist soil; apparently infrequent. Becraft Mountain, *2245;* Riders Mills, *2208;* New Lebanon, *House 15607**.

10. **Linaria** Mill.

1. Flowers yellow; corolla 15 to 20 mm. long *L. vulgaris*

1. Flowers violet-purple; corolla about 10 mm. long *L. canadensis*

L. vulgaris Hill. Butter-and-eggs. Roadsides, pastures and in waste or cultivated grounds; a common weed.

L. canadensis (L.) Dumont. Blue toadflax. Dry soil, or in rocky open woods; occasional, in the eastern part of our area. Usually appearing as if introduced. Berry Pond, Hancock, *3782;* 1.5 miles southwest of Canaan Center, *3597;* Long Pond, Ancram, *3438.*

11. **Chaenorrhinum** Reichenb.

C. minus (L.) Lange. Railroad embankments; occasional and locally abundant. 1 mile east of Pulvers Station, Ghent, *1490*.

12. **Veronicastrum** Fabricius

V. virginicum (L.) Farw. Culver's root. Moist meadows and alluvial soil along the larger streams; frequent, in the Hudson and Harlem Valleys. Schodack, *1557**; 1.5 miles north of Kinderhook, *1423**; Waldorf Pond, *House 20918**; Copake Falls, *Meredith** (PH); along Roeliff Jansen Kill, Ancram, *House 20532**; Pine Plains, *Peck**.

13. **Veronica** L. Speedwell

1. Main stem ending in an inflorescence, its flowers densely crowded or remote and axillary, in all cases the upper bract leaves alternate, *2*
  2. Plants perennial from a creeping matted base; corolla whitish with blue-violet lines *V. serpyllifolia*
  2. Plants annual with delicate fibrous roots, not creeping, *3*
    3. Plant smooth or essentially so; corolla white *V. peregrina*
    3. Plant hairy; corolla deep blue *V. arvensis*
1. Main stem never ending in an inflorescence, the leaves opposite throughout and the flowers all in axillary racemes, *4*
  4. Capsule pubescent; stem and leaves pubescent; plants of dry soil, *5*
    5. Leaf blades sessile or nearly so; sepals unequal, the longer 4 to 5 mm. long; corolla 5 to 10 mm. long, *6*
      6. Corolla 7 to 10 mm. long, violet-blue; capsule longer than wide; leaf blades coarsely dentate *V. latifolia*
      6. Corolla 5 to 6 mm. long, pale violet-blue; capsule wider than long; leaf blades crenate *V. Chamaedrys*
    5. Leaf blades crenate-serrate, narrowed to a petiolar base; sepals equal, 2 to 3 mm. long; corolla 3 to 4 mm. long; stem prostrate, ascending at tip *V. officinalis*
  4. Capsule glabrous or with a few gland-tipped hairs; stems and leaves glabrous or nearly so; plants more or less aquatic, *7*
    7. Leaf blades linear or lanceolate; capsule much wider than long; pedicels filiform, reflexed in fruit *V. scutellata*
    7. Leaf blades not narrow; oblong-ovate to lanceolate; capsule scarcely wider than long; pedicels ascending-spreading in fruit, *8*
      8. Leaf blades all petioled, lanceolate to ovate, widest near the base *V. americana*
      8. Leaf blades, at least the upper on the flowering stems, sessile and clasping, *9*
        9. Sepals acute to acuminate; capsule not or scarcely notched; racemes usually 30- to 60-flowered *V. Anagallis-aquatica*
        9. Sepals obtuse to subacute; capsule evidently notched; racemes usually 15- to 30-flowered *V. connata*

V. serpyllifolia L. Meadows, pastures and moist banks; frequent, weedy.

V. arvensis L. Woods and fields; apparently rather frequent; weedy.

V. latifolia L. Fields and roadsides; occasional. Curtis Mountain, *House 21478*; Chatham Center, *1056*.

V. peregrina L. Damp places, in waste and cultivated ground; occasional.

V. Chamaedrys L. An immature plant, from north of the Canaan Shakers, Canaan, *House 21205*, is apparently this species.

V. officinalis L. Woods and fields; weedy, common throughout and often appearing as if indigenous.

V. americana (Raf.) Schwein. Brooklime. Springy places and along streams; frequent. Bachus Pond, *3169;* 1 mile north of Kinderhook, *779**; 1 mile northwest of Brainard, *House 21399;* Berry Pond, Hancock *3776;* 3 miles south of Boston Corners, *3413.*

V. Anagallis-aquatica L. Springy places and along streams, often in calcareous situations; infrequent. Locally abundant in the Hudson and Harlem Valleys. 2 miles south of Copake, *3351;* 1 mile south of Ancramdale, *3376;* Millerton, *House 22396;* 1.5 miles southeast of Clermont, *3239.*

V. connata Raf. (*V. comosa* of *Gray's Manual*). Wet places along streams; rare, in calcareous regions. Becraft Mountain, *4005;* Miller Pond, Ancram, *3444.*

V. scutellata L. Ditches and swampy places; frequent throughout.

14. Aureolaria Raf.

1. Corolla glandular-pubescent on the outside; plant sticky-glandular; leaves finely dissected *A. pedicularia*
1. Corolla glabrous on the outside; plant smooth or pubescent, not glandular; leaves entire to coarsely bipinnatifid, not finely dissected, 2
   2. Stem and leaves permanently downy-pubescent; capsule densely brown-pubescent; pedicels 1.5 to 3 mm. long *A. virginica*
   2. Stem glabrous, glaucous; capsules glabrous; pedicels 5 to 25 mm. long *A. flava*

A. pedicularia (L.) Raf. (*Gerardia* of *Gray's Manual*). Dry sandy or rocky woods, usually in acid soil; rather frequent in the Harlem Valley; rare in the lower Hudson Valley, and reported from as far north as Kinderhook (Wright & Hall, 1836). Copake Falls, *Britton et al.** (NY); Robinson Pond, *3957;* Long Pond, Ancram, *3437;* Upper Twin Pond, Elizaville, *3278;* [Claverack, *Rev. A. P. Van Gieson* (V)].

A. virginica (L.) Pennell (*Gerardia* of *Gray's Manual*). Downy false foxglove. Dry sandy or rocky woods, usually in acid soil; frequent. Kinderhook Lake, *House 18866**; 3 miles south of Kinderhook, *1437**; Forest Lake, *2045;* 1 mile east of Pulvers Station, Ghent, *1493;* Blue Hill, *2186;* Tivoli, *2767** (PENN).

A. flava (L.) Farw. (*Gerardia* of *Gray's Manual*). Smooth false foxglove. Habitat of the preceding species; frequent eastward, but unknown in the Hudson Valley. Lebanon Springs, *Harrison* (US); No Bottom Pond, *1936;* 2.5 miles east of Chatham Center, *3676;* Forest Lake, *2041;* 1 mile north of Copake, *828;* Pine Plains, *Hoysradt* (US).

15. Gerardia L.

1. Pedicels not more than twice the length of the calyx *G. paupercula*
1. Pedicels 2 to 6 times the length of the calyx *G. tenuifolia*

G. paupercula (Gray) Britt. Calcareous marshes in the Harlem Valley; locally very abundant. Copake Falls, *Britton et al.** (NY); north of Copake Falls, *3906;* Pulvers Corners, *3852.* Reports of *G. purpurea* L. from our area (Hoysradt, 1875-79, and House, 1924), are probably based on occurrences of *G. paupercula.*

G. tenuifolia Vahl. Dry shaly hillsides, woods and meadows; frequent in the Hudson and Harlem Valleys. Unknown northeastward.

16. Pedicularis L. Lousewort

1. Leaves opposite, nearly sessile; plant often 50 cm. high or more; flowering period August to October *P. lanceolata*

1. Leaves alternate, long-petioled; plant 10 to 30 cm. high; flowering period May to June *P. canadensis*

P. lanceolata Michx. Moist banks along the Hudson River, above tide-level; infrequent, but locally abundant. South of Poelsburg, *3795;* Columbiaville, *4036;* Madalin, mouth of Stony Creek, according to Svenson (1935).

P. canadensis L. Woods and meadows, especially in sandy soil; common throughout.

17. Melampyrum L.

M. lineare Desr. "Cow wheat." Dry acid soil in woods and on wooded banks; common. Represented in our area only by var. **latifolium** (Bart.) Bart.

LENTIBULARIACEAE (Bladderwort Family)

Utricularia L. Bladderwort

1. Plant apparently scapose, the flowering stem erect, 4 to 30 cm. high, 1- to 5-flowered; creeping stems immersed in mud or peat, so delicate that they are rarely seen; bracts at base of pedicel accompanied by two smaller bracteoles; spur of corolla sharp, 10 to 12 mm. long *U. cornuta*

1. Plants with elongated slender creeping or floating stems, some or all of the leaves bearing bladders; pedicel bracts without bracteoles, *2*

2. Leaves 2 to 5 cm. long, pinnate, with numerous capillary divisions; stems free-floating except for one point of attachment *U. vulgaris*

2. Leaves less than 2 cm. long, forking rather than pinnate; stems creeping on bottom in shallow water or near it, *3*

3. Leaves on branches without bladders; bladders on branches almost without leaves; divisions of the leaf toothed, linear, flat, not capillary; corolla 1 to 1.5 cm. broad *U. intermedia*

3. Branches all equally bladder-bearing; divisions of the leaves capillary or nearly so; corolla 4 to 8 mm. broad, *4*

4. Pedicels recurved in fruit; bladders 1.5 to 1.8 mm. long; spur almost none *U. minor*

4. Pedicels erect in fruit; bladders 1 to 1.5 mm. long; spur blunt, conic, shorter than the lower lip *U. gibba*

U. cornuta Michx. Acid bogs; rare. Locally abundant at Taplins' Pond, Stephentown, *2419*; "Finger Marsh," Gallatin, *3580.* Reported by Hoysradt (1875-79) from Pine Plains.

U. vulgaris L. Lakes and ponds; common, throughout. Represented in our area only by var. **americana** Gray.

U. intermedia Hayne. Muddy borders of ponds; locally abundant. Knickerbocker Lake, *1231; 2* miles northwest of Copake Falls, *3588;* seen also in a calcareous marsh at Pulvers Corners.

U. minor L. In our area known only from shallow water in a calcareous bog west of Douglas Knob, New Lebanon, *2125*

U. gibba L. In our area known only from Sutherland Pond, Chatham, where it is rather abundant in shallow water, *2129.*

OROBANCHACEAE (Broom-rape Family)

1. Flowers solitary on naked peduncles; plants unbranched above the base **1. Orobanche**

1. Flowers racemose, the upper sterile, with long filaments and style, the lower fertile; plants much branched **2. Epifagus**

1. Orobanche L.

O. uniflora L. Broom-rape. Moist woods and thickets; rather infrequent. Cedar Mountain, Copake, *136* (PENN); Kinderhook, *663;* [1 mile north of Nassau, *Wibbe*].

2. Epifagus Nutt.

E. virginiana (L.) Bart. Beechdrops. In woods, under beech trees; frequent. Mount Lebanon; 4 miles north of Nassau; Stuyvesant Falls; 2 miles east of Spencertown; 4 miles north of Lebanon Springs; north of Brace Mountain.

PHRYMACEAE (Lopseed Family)

Phryma L.

P. Leptostachya L. Lopseed. Moist soil in woods; frequent.

PLANTAGINACEAE (Plantain Family)

Plantago L. Plantain

1. Plants scapose, with basal leaves, *2*
  2. Leaves broadly elliptic, ovate or cordate, abruptly contracted to long petioles, *3*
    3. Ribs of the leaves arising from the midribs (that is, the blade pinnately veined) *P. cordata*
    3. Ribs of the leaves arising from the contracted base of the blade (blade appearing palmately veined), *4*
      4. Capsule circumscissile about the middle, ovate; sepals and bracts rounded, obtuse *P. major*
      4. Capsule circumscissile much below the middle, long-cylindric; sepals and bracts strongly keeled, more or less acute *P. Rugelii*
  2. Leaves lanceolate to oblong or linear, tapering to a short petiole, *5*
    5. Leaves lanceolate to lance-oblong, strongly ribbed; scape 20 to 70 cm. high; bracts not exceeding the flowers *P. lanceolata*
    5. Leaves narrowly lanceolate; scape rarely more than 15 cm. high; bracts spikelike, 2 to 6 times as long as the flowers *P. aristata*
1. Plants with some or all the leaves cauline, opposite or whorled *P. indica*

P. cordata Lam. Rocky coves and near mouths of streams; abundant near high tide level along the Hudson River; unknown elsewhere. Hotaling Island, *3133;* Nutten Hook, *853;* Rogers Island, *4466;* mouth of Roeliff Jansen Kill, *1583;* Cheviot, *2826;* Magdalen Island, *2686.*

P. major L. Fields, meadows and lawns, and in wet places; very common, and often a persistent weed.

P. Rugelii Dcne. Seen along the Hudson River in several localities; weedy. Doubtless elsewhere.

P. lanceolata L. English plantain, "rib grass." Fields, lawns and waste places; a very common weed.

P. aristata Michx. Dry sandy or gravelly soil; rather infrequent and only locally abundant; weedy. Kinderhook Lake, *Brown 81;* Kinderhook, *1183;* [Knickerbocker Lake, *House 23704*].

P. indica L. On cinders along the New York Central Railroad at Cheviot, *2817.* Adventive from Europe.

RUBIACEAE (Madder Family)

1. Slender herbs with whorled leaves; stems square; fruit of two dry globular indehiscent 1-seeded carpels **4. Galium**

1. Leaves opposite (or in 3's in the shrubby genus *Cephalanthus*); fruit not as above, *2*
2. Shrub or small tree with white flowers in dense spherical peduncled heads **2. Cephalanthus**
2. Herbs with flowers solitary or in few-flowered clusters, *3*
3. Flowers in pairs with the ovaries united; corolla white, densely bearded inside; plants trailing on the ground, evergreen; fruit a red insipid berry **3. Mitchella**
3. Flowers solitary or in small cymes, bluish or purplish; stems erect, not evergreen; fruit a bilocular loculicidal capsule containing 4 to 40 seeds **1. Houstonia**

1. **Houstonia** L.

1. Peduncles 1-flowered, filiform, erect, 2 to 5 cm. long; leaves oblong-spatulate, 6 to 9 mm. long *H. caerulea*
1. Flowers in small terminal clusters on short pedicels; leaves oblong-lanceolate to linear, 1.5 to 2.5 cm. long *H. longifolia*

H. caerulea L. Bluets, Quaker ladies. Meadows and moist woods; common in the eastern tier of towns. Unknown elsewhere, although reported by Woodworth (1840) from Kinderhook. New Lebanon, *Iva Allen;* Canaan, *4142* (GH); Canaan Center, *3615;* Austerlitz, *706;* Green River, *3524;* Boston Corners, *382* (PENN); [north of Brace Mountain, *House 24820*].

H. longifolia Gaertn. Dry sandy or rocky hillsides; infrequent. Curtis Mountain, *House 21472;* Perry Peak, Canaan, *3651;* 1 mile northwest of Kinderhook Lake, *902;* seen also on Crugers' Island, Hudson River.

2. **Cephalanthus** L.

C. occidentalis L. Buttonbush. Swamps and margins of ponds, or often in stagnant water in small boggy depressions; frequent.

3. **Mitchella** L.

M. repens L. Partridge berry. Woods and grassy banks, in dry soil, or on hummocks in bogs and swamps; common.

4. **Galium** L. Bedstraw

1. Ovary and fruit bristly or hispid, *2*
2. Erect or ascending plants, neither the stems nor leaves retrorsely scabrous, *3*
3. Flowers sessile or nearly so, along the primary branches of the inflorescence, *4*
4. Leaves lanceolate-acuminate; flowers deep purple, glabrous *G. lanceolatum*
4. Leaves oval or oblong, obtuse; flowers greenish yellow, commonly pubescent *G. circaezans*
3. Flowers distinctly pedicelled, in compact or leafy panicles, *5*
5. Leaves oval, hairy; flowers greenish purple *G. pilosum*
5. Leaves narrowly lanceolate, glabrous; flowers bright white *G. boreale*
2. Matted, reclining or ascending plants, the stems retrorsely scabrous, *6*
6. Leaves mostly 8 at each node, linear or narrowly oblanceolate *G. Aparine*
6. Leaves 6 at each node, elliptic *G. triflorum*

1. Ovary and fruit glabrous or sometimes minutely roughened, *7*
  7. Flowers yellow — *G. verum*
  7. Flowers white, *8*
    8. Leaves cuspidate, the blade tipped with a sharp and rigid point, *9*
      9. Leaves 6 at a node on the main stems, 4 or 5 on the branches; plants very rough, the leaves almost prickly — *G. asprellum*
      9. Leaves 8 at a node on the main stems, 6 on the branches; plants only very slightly rough — *G. Mollugo*
    8. Leaves not tipped by a rigid spinelike point, *10*
      10. Flowers numerous in a terminal panicle — *G. palustre*
      10. Flowers solitary or in 2's or 3's, *11*
        11. Corolla 4-lobed, the lobes acute; stems mostly smooth, *12*
          12. Leaves ascending, 1.5 to 2.5 cm. long; fruit 2.5 to 3.5 mm. in diameter — *G. obtusum*
          12. Leaves mostly strongly reflexed, 0.5 to 1.5 cm. long; fruit 1 to 1.5 mm. in diameter — *G. labradoricum*
        11. Corolla commonly with three obtuse lobes; stems retrorsely scabrous, *13*
          13. Pedicels straight, glabrous — *G. tinctorium*
          13. Pedicels slender, arcuate, scabrous — *G. trifidum*

G. verum L. Yellow bedstraw. Fields and roadsides; common in the northern part of the Hudson Valley; occasional elsewhere. Malden Bridge, *929;* Valatie, *4762* (USNA).

G. Aparine L. Cleavers, "goose grass." Moist woods and ravines; rather frequent on the clay and limestone soils of the Hudson Valley. Apparently infrequent eastward. Nutten Hook, *855;* 3 miles north of Claverack, *559;* Columbiaville, *451* (PENN).

G. pilosum Ait. Dry shaly hillsides; rare. Blue Hill, *2424* (PENN); Cedar Mountain, Copake, *3569.*

G. lanceolatum (Torr.) Torr. Dry loamy, sandy or rocky woods; frequent, throughout.

G. circaezans Michx. Dry woods; common, throughout. Represented in our area only by var. **hypomalacum** Fern.

G. boreale L. Dry banks, in shaly or clay soil; rare. Curtis Mountain, *House 21476;* Columbiaville, *3728;* 1 mile west of Stuyvesant Falls, *4745* (USNA).

G. triflorum Michx. Sweet-scented bedstraw. Woods, thickets and wooded swampy places; common.

G. Mollugo L. Stockport weed. Fields and roadsides; extensively naturalized and often a pest on the clays and shales of the Hudson Valley; elsewhere occasional, spreading. Outside of the Hudson Valley known from Canaan, *Peck;* south of Mount Riga Station, *3375.*

G. obtusum Bigel. Moist woods and swampy borders of ponds; infrequent. Poelsburg, *894;* Waldorf Pond, *House 20917;* west of Brainard, *House 21470;* near small pond south of Miller Pond, Ancram, *House 20536;* 3 miles north of Ancramdale, *3890.*

G. labradoricum (Wieg.) Wieg. Open calcareous marshes, in the Hudson and Harlem Valleys; locally abundant. 1 mile east of Fowlers' Lake, *1432;* Copake Falls, *3910;* Miller Pond, Ancram, *House 20546;* 3 miles north of Ancramdale, *3406.*

G. trifidum L. Open swamps and borders of ponds, often in sphagnous situations; frequent eastward. Apparently rare in the Hudson Valley. North Chatham, *House 20472;* Knickerbocker Lake, *1574;* Fowlers' Lake, *1673;* 2 miles south of Copake Lake, *3449;* 2 miles southeast of Taghkanic, *3359;* seen also at New Britain.

G. tinctorium L. Moist wooded swamps and borders of ponds, often in sphagnous situations; frequent eastward. Little known in the Hudson Valley. Stuyvesant Falls, *2027;* New Britain, *3634;* No Bottom Pond, *1957;* 2 miles south of Copake Lake, *3450;* 1.5 miles south of Ancramdale, *3377;* [Knickerbocker Lake, *House 23709*].

G. palustre L. Wet places along streams; infrequent or rare. One-half mile west of Brainard, *House 21364;* Kinderhook, along Kinderhook Creek, *1364;* North Bay, Tivoli, *2662* (PENN).

G. asprellum Michx. Moist thickets and open swamps; frequent. 3 miles southeast of Harlemville, *1902* (PENN); Boston Corners, *1660;* [Claverack, *Rev. A. P. Van Gieson* in 1870 (V)]. Seen also in the towns of Kinderhook (House), Canaan and Copake.

CAPRIFOLIACEAE (Honeysuckle Family)

1. Plants erect, herbaceous; flowers sessile in the axils of the upper leaves, solitary or in small clusters; fruit a hard drupe, bright orange-red, containing 3 bony nutlets 3. **Triosteum**

1. Plants shrubby, erect or climbing, *2*

2. Leaves pinnate; flowers white, in broad compound cymes; fruit red or dark purple, containing 3 to 5 seeds, juicy 1. **Sambucus**

2. Leaves simple, *3*

3. Fruit a slender pointed bilocular many-seeded pod; leaves serrate, pointed; flowers yellow 5. **Diervilla**

3. Fruit fleshy, 1- to several-seeded; flowers white or colored, *4*

4. Leaves entire; corolla tubular or funnel-form, usually irregular; fruit a bilocular or trilocular fleshy berry containing several seeds; flowers in axillary clusters 4. **Lonicera**

4. Leaves toothed or lobed, rarely entire; corolla wheel-shaped, regular; fruit a 1-seeded drupe; flowers in compound cymes 2. **Viburnum**

1. Sambucus L.

1. Flowering period in May; pith reddish brown; fruit bright red *S. racemosa*

1. Flowering period June to July; pith white; fruit purplish to almost black *S. canadensis*

S. racemosa L. (*S. pubens* of *Gray's Manual*). Red-berried elder. Cool rocky woods; frequent eastward, especially at elevations above 300 meters; rare in the Hudson Valley. Stuyvesant Falls, *510;* 2 miles east of Ghent, *754;* Red Hook, *4154* (GA); 3 miles north of Ancramdale, *3342.*

S. canadensis L. Elderberry. Moist grounds; common. Very abundant in the Hudson and Harlem Valleys, and decreasing eastward. Infrequent at elevations above 300 meters.

2. Viburnum L.

1. Marginal flowers of the cyme much enlarged and very showy, neutral, *2*

2. Leaves pinnately veined, not lobed, rusty-scurfy beneath, round-ovate, heart-shaped at base *V. alnifolium*

2. Leaves palmately veined, 3-lobed, nearly glabrous; petioles bearing 2, often pedicelled, glands at apex *V. Opulus*

1. Flowers all small and uniform, perfect, *3*

3. Leaves palmately veined, 3-lobed, soft-downy beneath; fruit purple-black *V. acerifolium*

3. Leaves pinnately veined, subentire or variously toothed, but not lobed, *4*
4. Leaves prominently, usually coarsely, toothed; main veins straight, more or less parallel, conspicuous, *5*
5. Twigs, buds and leaves more or less densely stellate-tomentose; winter buds naked, without covering scales *V. Lantana*
5. Twigs, buds and leaves smooth or glandular, not stellate-tomentose; winter buds scaly, *6*
6. Leaf very short-petioled, often almost sessile; stipules slender, conspicuous, often exceeding the petiole; leaf downy beneath *V. Rafinesquianum*
6. Leaf relatively long-petioled, the petiole much longer than the small or obsolete stipules; leaf very nearly glabrous beneath *V. recognitum*
4. Leaves finely crenate-serrate or subentire; veins irregular and inconspicuous, curved and running together, *7*
7. Cyme usually 5-rayed, on a peduncle shorter than itself; leaves short-pointed, not long caudate-acuminate; fruit 6 to 9 mm. long *V. cassinoides*
7. Cyme usually 3- to 4-rayed, sessile; leaves, at least the upper, long caudate-acuminate; fruit 10 to 15 mm. long. *V. Lentago*

V. alnifolium Marsh. Hobblebush. Ravines and cool woods; rather frequent northeastward, at elevations of 300 meters or more; unknown westward. Canticoke Swamp, *1701* (PENN); Lebanon Springs, *2414;* south of Perry Peak, Canaan, *3656;* No Bottom Pond, *472;* gorge of Bashbish Brook, Copake, *3560.*

V. Opulus L. (*V. trilobum* of *Gray's Manual*) Highbush cranberry. Swamps, or rarely in dry woods; frequent eastward. Rare in the Hudson Valley. North Chatham, *Ring*; west of Post Road School, Kinderhook, *264*; Tivoli, *2989*; New Lebanon, *House 21294;* Austerlitz, *2290;* 3 miles southeast of Harlemville, *1125;* 3 miles north of Ancramdale, *1077;* Pulvers Corners, *3870;* [Claverack, *Rev. A. P. Van Gieson* (V)]. Represented in our area by var. **americanum** Ait.

V. acerifolium L. Arrow-wood. Woods and thickets; common throughout.

V. Rafinesquianum Schultes. Dry rocky hillsides, usually in neutral or noncalcareous soils; rather infrequent, but widely distributed and locally abundant. Old Chatham, *641;* Cedar Mountain, *135* (PENN); 3 miles north of Ancramdale, *799;* Kinderhook Lake, *House 13416;* Stuyvesant Falls, *617;* 2 miles east of Ghent, *749;* Blue Hill, *614;* [Brace Mountain, *House 24848;* Stissing Mountain, *House 21019;* North Chatham, *House 20940*].

V. recognitum Fern. Arrow-wood. Open swamps and in moist woods; common.

V. cassinoides L. Wild raisin. Swamps and borders of ponds; rather infrequent, especially in the Hudson Valley, but widely distributed. New Britain, *3637;* New Lebanon, *2402;* No Bottom Pond, *462;* Copake Falls, *3586;* bog southeast of Knickerbocker Lake, *1012;* West Ghent, *1119;* [Claverack, *Rev. A. P. Van Gieson* (V)].

V. Lentago L. Swamps and moist woods; frequent.

V. Lantana L. Wayfaring tree. A plant, apparently of this species, was collected at Mount Merino, *House 22643.* Not known elsewhere.

3. Triosteum L.

T. perfoliatum L. "Horse gentian." Dry or moist woods and thickets, often in calcareous soil; rather frequent. Malden Bridge, *909* [var. *glaucescens* (Wieg.) Wieg.]; Kinderhook Lake *House 18862*; Kinderhook, *778*; Columbiaville, *4044;* 2 miles east of Greendale, *4331* (GA); Green River, *1529;* 3 miles north of Ancramdale, *800.* Represented in our area by var. **aurantiacum** (Bickn.) Wieg. (*T. aurantiacum* of *Gray's Manual*).

4. **Lonicera** L. Honeysuckle

1. Upright bushy shrubs with flowers on 2-flowered axillary peduncles; leaves all distinct, the upper ones not connate; calyx teeth deciduous, *2*
2. Peduncles short, 3 to 7 mm. in length; berry blue, formed of two united ovaries *L. villosa*
2. Peduncles long and slender, 1.4 to 3 cm. in length, *3*
3. Corolla greenish yellow; leaves ciliate *L. canadensis*
3. Corolla rose-colored or white; leaves entirely glabrous *L. tatarica*
1. Twining shrubs with flowers in sessile whorled clusters in the axils of the usually connate upper leaves; calyx teeth persistent on the berry, *4*
4. Branches glandular-hairy; leaves hairy on both sides *L. hirsuta*
4. Branches and leaves glabrous; leaves glaucous beneath *L. dioica*

L. hirsuta Eat. Dry sandy soil at edge of woods, 1 mile west of Lebanon Springs, *4290*. Also reported from Lebanon Springs by Dr. A. K. Harrison (in lit.). Otherwise unknown.

L. dioica L. Dry rocky woods and banks; common throughout.

L. tatarica L. Tartarian honeysuckle. Common in cultivation, and occasionally established in woods and along roadsides.

L. canadensis Marsh. Ravines and rocky woods; rather frequent on the shales in the Hudson Valley; common eastward, at elevations of 300 meters and above; elsewhere infrequent. Poelsburg, *352;* bluff near mouth of Roeliff Jansen Kill, *369;* Stuyvesant Falls, *517;* Canaan Center, *1046;* along Kleine Kill, southeast of Chatham, *4110* (GA); Taghkanic Creek at New Forge, *3475;* Washburn Mountain, Copake, *3331*.

L. villosa (Michx.) Muhl. var. **tonsa** Fern. In a wooded sphagnum bog west of New Britain cemetery, New Lebanon, *4307*. Otherwise unknown.

5. **Diervilla** Mill.

D. Lonicera Mill. Bush honeysuckle. Dry woods and thickets; common throughout.

VALERIANACEAE (Valerian Family)

1. Some of the leaves pinnatifid; ovary unilocular, 1-seeded; sepals resembling plumose bristles 1. **Valeriana**
1. Leaves mostly entire, never pinnatifid; ovary trilocular, 1-seeded; sepals minute, not plumose 2. **Valerianella**

1. **Valeriana** L.

V. sitchensis Bong. subsp. **uliginosa** (T. & G.) F. G. Mey. (*V. uliginosa* of *Gray's Manual*). Valerian. Calcareous marshes; frequent and locally very abundant in the Harlem Valley; occurs in the Hudson Valley. West of Post Road School, Kinderhook, *724;* Miller Pond, Ancram, *1075;* 3 miles north of Ancramdale, *809;* Pulvers Corners, *3866;* Pine Plains, *Hoysradt* (GH, NY, US).

2. **Valerianella** Mill.

1. Fruit trilocular, the single fertile compartment ⅓ to ½ the combined width of the 2 sterile compartments; fruits generally glabrous *V. umbilicata*
1. Fruit trilocular, the fertile compartment equalling or wider than the combined width of the sterile compartments; fruits generally pubescent *V. radiata*

V. umbilicata (Sulliv.) Wood. Corn salad. New Baltimore, *Howe* in 1870 (according to Dyal, Rhodora **40**: 195. 1938). Otherwise unknown.

V. radiata (L.) Dufr. Corn salad. This species and the preceding one were reported from New Baltimore, Greene County, by E. C. Howe (24th Report N. Y. State Mus. 56-57. 1872). His specimens are now in the herbarium of the museum, but are in such poor condition as to make it impossible to name them with assurance.

DIPSACACEAE (Teasel Family)

Dipsacus L.

D. sylvestris Huds. Teasel. Fields and pastures; occasional, locally established.

CUCURBITACEAE (Cucumber Family)

1. Leaves shallowly 5-angled; corolla of the sterile flowers 5-lobed; fruit dry and indehiscent, 1-seeded **1. Sicyos**

1. Leaves deeply and sharply 5-lobed; corolla of the sterile flowers deeply 6-parted; fruit fleshy, bursting at summit, 4-seeded **2. Echinocystis**

1. Sicyos L.

S. angulatus L. One-seeded cucumber. Moist thickets along streams; frequent in the Hudson Valley and known to occur in the Harlem Valley. Unknown northeastward. Stuyvesant, *House 13292;* Kinderhook, *1984;* Columbiaville, *3699;* Becraft Mountain, *2246;* 2 miles east of Germantown, *2931;* Pine Plains, *House 21056.*

2. Echinocystis T. & G.

E. lobata (Michx.) T. & G. Wild or bur cucumber. Moist thickets along streams; frequent in the Hudson and Harlem Valleys and northeastward in the valley of the Kinderhook Creek. Apparently not found away from the larger streams. Stuyvesant, *House 13304;* Niverville, *1792;* Riders Mills, *1265;* Chatham, *1760;* Kinderhook, *2093;* along Jansen Kill (that is, probably in the town of Ancram), according to Hoysradt (1875-79).

CAMPANULACEAE (Bellflower Family)

1. Flowers pedicelled, in a terminal inflorescence; capsule broad, obconic to globose **1. Campanula**

1. Flowers sessile, solitary or 2 or 3 together in the axils of the broad clasping leaves; capsule slender-cylindric **2. Triodanis**

1. Campanula L.

1. Flowers short-pedicelled, nearly sessile, in terminal spikes or racemes, *2*
  2. Style declined; capsule with pores near apex *C. americana*
  2. Style straight; capsule with pores at base *C. rapunculoides*

1. Flowers few to many, on slender peduncles or in loose inflorescences, *3*
  3. Flowers intense purplish blue; stems erect, smooth, not scabrous on the angles *C. rotundifolia*
  3. Flowers white or very pale bluish, drying bluish white; stems reclining among marsh herbs, retrorsely scabrous on the angles *C. aparinoides*

C. rotundifolia L. Harebell. Steep rocky hillsides and bluffs; frequent, showing no lime preference.

C. rapunculoides L. European bellflower. Roadsides and old dooryards; common and locally abundant, often forming considerable patches.

C. aparinoides Pursh (including *C. uliginosa* of *Gray's Manual*). Wet meadows, swamps and borders of ponds; frequent, in neutral or calcareous soils. North Chatham, *House 20474;* Knickerbocker Lake, *1573;* Brainard, *House 18416, House 21929;* Kinderhook Creek near Valatie, *1890;* Kinderhook, *1371* (PENN), *1421;* 1 mile east of Fowlers' Lake, *1433;* shore opposite Rogers Island, *2959;* 2 miles southeast of Taghkanic, *3358;* rocky ravine 1 mile northeast of Queechy Lake, *3653;* 3 miles north of Ancramdale, *3346;* Miller Pond, Ancram, *1652* (PENN); south of Mount Riga Station, *3367.*

C. americana L. Unknown at present, and perhaps never a member of our flora, but reported several times: Hudson, by Stebbins (1830; as *C. acuminata*); Kinderhook, by Woodworth (1839); Troy, by Wright and Hall (1836); Amenia, by Winchell (1851). The recent discovery of such species as *Magnolia acuminata* and *Hydrastis canadensis* in our area lends weight to the opinion that *Campanula americana* may once have occurred there.

2. Triodanis Raf.

T. perfoliata (L.) Nieuwl. (*Specularia* of *Gray's Manual*). Venus' looking-glass. Dry woods and clearings, and sandy banks; common, weedy.

LOBELIACEAE[1] (Lobelia Family)

Lobelia L.

1. Flowers red (rarely white), mostly 3 to 4.5 cm. long when straightened out *L. Cardinalis*

1. Flowers blue or purplish, sometimes pale, *2*

  2. Flowers about 2.5 to 3 cm. long when straightened out; calyx hirsute, the sinuses with conspicuous reflexed foliaceous auricles *L. siphilitica*

  2. Flowers smaller, not over 2.2 cm. long; auricles none or very small, not foliaceous, *3*

    3. Plants aquatic; leaves basal, linear, terete, hollow *L. Dortmanna*

    3. Plants terrestrial; leaves flat, some cauline, *4*

      4. Leaves linear to linear-oblanceolate; pedicels with two tiny bracteoles about the middle *L. Kalmii*

      4. Leaves broader, elliptic to ovate; pedicels with bracteoles at base, *5*

        5. Stem much branched, especially in age, usually long-hirsute; capsules much inflated in fruit *L. inflata*

        5. Stem strict, simple, never long-hirsute (merely short-pubescent near base); capsules firm, not inflated in fruit, *6*

          6. Anthers blue; calyx flattish in anthesis *L. spicata*

          6. Anthers white; calyx roundish in anthesis *L. spicata* var. *campanulata*

L. Dortmanna L. In shallow water, in lakes and ponds with sandy or gravelly bottom. Common northward, and on Long Island, but in our area probably occurs only at Riga Lake, Litchfield County, *4481.*

L. Cardinalis L. Cardinal flower. Margins of streams and ponds, and in wet meadows; common in the Hudson Valley, but apparently much less so eastward. No Bottom Pond, *1342;* Robinson Pond, *1920* (PENN); pond south of Miller Pond, Ancram, *House 20535;* [Kinderhook Lake, *House 13408*].

L. siphilitica L. Wet woods and swamps; common in the Hudson Valley; occurs in the Harlem Valley, where known from a station 3 miles north of Ancramdale, *3883;* at New Lebanon, according to House; otherwise unknown eastward.

[1] Frequently considered a subfamily of *Campanulaceae*, as in *Gray's Manual.*

L. spicata Lam. Pastures, rich fields and wooded banks; common in the Hudson and Harlem Valleys, and on the high hills of the towns of Copake and Ancram. Unknown northeastward. Var. **campanulata** McVaugh, occurs with the typical variety but is much less abundant.

L. inflata L. "Indian tobacco." Dry soil in fields, woods and along roadsides; common, weedy.

L. Kalmii L. Calcareous marshes and meadows, or in circum-neutral soil around lakes; very abundant in suitable situations. Bog west of Post Road School, Kinderhook, *3006* (GA); from the same locality a white-flowered form, *2000;* Knickerbocker Lake, *1996;* Canaan, *E. C. Howe;* Copake Falls, *3905;* 3 miles north of Ancramdale, *3895;* Pulvers Corners, *3845.*

COMPOSITAE (Aster Family)

1. Flowers of the head all with strap-shaped corollas; juice usually milky, *2*
  2. Pappus of scales, or of scales and bristles together, *3*
    3. Flowers blue or whitish — 1. **Cichorium**
    3. Flowers yellow — 2. **Krigia**
  2. Pappus of capillary or plumose bristles, *4*
    4. Pappus bristles plumose — 3. **Tragopogon**
    4. Pappus bristles all capillary, *5*
      5. Achenes minutely spiny near apex; plants acaulescent; head solitary, on a smooth hollow peduncle — 4. **Taraxacum**
      5. Achenes not spiny near apex; plants not as above, *6*
        6. Achenes flattened, *7*
          7. Body of achene truncate at summit; heads large, 10 to 40 mm. in diameter — 5. **Sonchus**
          7. Body of achene with a narrow neck or beak; heads small, 4 to 10 mm. in diameter — 6. **Lactuca**
        6. Achenes not flattened, but cylindric-columnar or oblong, *8*
          8. Flowers white, cream-colored or pinkish — 8. **Prenanthes**
          8. Flowers yellow or orange — 7. **Hieracium**

1. Flowers with tubular corollas, or the outer ones prolonged and straplike, or those of the pistillate flowers reduced or wanting, *9*
  9. Pistillate flowers apetalous or with much-reduced corollas; anthers nearly free, merely converging about the stigma, *10*
    10. Involucre not closed and woody; staminate and pistillate flowers in the same head — 9. **Iva**
    10. Staminate and pistillate flowers in different heads, the pistillate involucre closed and woody, *11*
      11. Pistillate heads forming a bur with hooked spines — 11. **Xanthium**
      11. Pistillate heads small, not burlike — 10. **Ambrosia**
  9. Flowers all petaliferous, the corolla tubular or strap-shaped; anthers cohering in a tube, *12*
    12. Corollas all tubular; rays (strap-shaped corollas) none, *13*
      13. Pappus of capillary bristles, *14*
        14. Involucral bracts scarious throughout; plants more or less woolly, *15*
          15. Basal leaves much larger than the cauline leaves and differing from them in shape — 19. **Antennaria**
          15. Basal leaves none or, if present, similar to the cauline leaves, *16*
            16. Involucre papery white, the bracts spreading — 20. **Anaphalis**
            16. Involucre yellowish white or brownish, the bracts more or less appressed — 21. **Gnaphalium**
        14. Involucral bracts not wholly scarious, or, if apparently so, the plants not white woolly, *17*

17. Involucral bracts in one series, often with minute bracts at base, *18*
18. Plants climbing or twining 14. **Mikania**
18. Plants neither climbing nor twining, *19*
19. Marginal flowers pistillate only; heads 15 to 20 mm. long 35. **Erechtites**
19. Marginal flowers perfect; heads 7 to 10 mm. long 36. **Senecio**
17. Involucral bracts in 2 to many series, *20*
20. Foliage spiny; pappus plumose 38.**Cirsium**
20. Foliage not spiny, *21*
21. Involucral bracts fimbriate or dentate; corolla deeply lobed 39. **Centaurea**
21. Involucral bracts entire, *22*
22. Pappus double, the outer of very short, the inner of longer bristles 12. **Vernonia**
22. Pappus bristles all alike 13. **Eupatorium**
13. Pappus of scales, awns, a short crown, or none, *23*
23. Involucral bracts hooked, forming a bur; pappus of scales 37. **Arctium**
23. Involucral bracts not forming a bur, *24*
24. Pappus of 2 or 4 often barbed awns 26. **Bidens**
24. Pappus none or a short crown, *25*
25. Corolla large, deeply lobed; flowers pink or purple; involucral bracts mostly fimbriate 39. **Centaurea**
25. Corolla small, dentate; flowers yellow or yellowish white, *26*
26. Receptacle elongated, conic 31. **Matricaria**
26. Receptacle flat or convex 33. **Tanacetum**
12. Both tubular and strap-shaped corollas ("disk" and "ray" flowers) present, *27*
27. Pappus of capillary bristles; receptacle not chaffy, *28*
28. Rays yellow (white in *Solidago bicolor*), *29*
29. Involucral bracts in one series, often with minute bractlets at base, *30*
30. Heads solitary, on scapose scaly-bracted stems, appearing before the leaves 34. **Tussilago**
30. Heads several in a corymbose cyme; plants with leafy stems 36. **Senecio**
29. Involucral bracts in 3 to many series, *31*
31. Heads large, 2.5 to 10 cm. in diameter 22. **Inula**
31. Heads small, .5 to 1.5 cm. in diameter 15. **Solidago**
28. Rays violet, purple, blue or white, *32*
32. Bracts of the involucre in 1 or 2 series 18. **Erigeron**
32. Bracts of the involucre in 3 to 5 series, *33*
33. Rays 3 to 8; pappus-hairs all of same length; inflorescence a flat-topped corymb; leaves tapered to rounded at base 16. **Sericocarpus**
33. Rays usually more numerous; if 8 or less, plants not with combination of characters listed above 17. **Aster**
27. Pappus of awns, scales, a short crown, or none, *34*
34. Pappus of 2 or 4 often barbed awns 26. **Bidens**
34. Pappus not as above, *35*
35. Pappus of scales, which are sometimes deciduous, *36*
36. Receptacle chaffy, *37*
37. Rays white; heads very small 27. **Galinsoga**
37. Rays yellow; heads large 25. **Helianthus**

36. Receptacle not chaffy; rays yellow; stem strongly winged 28. **Helenium**

35. Pappus none or a mere crown, *38*

38. Receptacle not chaffy, nearly flat; rays white; disk flowers yellow 32. **Chrysanthemum**

38. Receptacle chaffy, *39*

39. Rays white or pinkish, *40*

40. Heads long-peduncled, terminating the branches, more than 1 cm. in diameter 30. **Anthemis**

40. Heads short-peduncled, in a large flat-topped inflorescence, less than 1 cm. in diameter 29. **Achillea**

39. Rays yellow, *41*

41. Leaves finely dissected; head 2.5 to 3.5 cm. broad 30. **Anthemis**

41. Leaves undivided or the lower lobed or pinnately parted; heads 5 cm. broad or more, *42*

42. Leaves opposite 23. **Heliopsis**

42. Leaves alternate 24. **Rudbeckia**

1. **Cichorium** L.

C. Intybus L. Chicory. Fields and roadsides; common, weedy. Locally abundant, especially on the clays of the Hudson Valley, where it is often the most conspicuous plant over considerable areas.

2. **Krigia** Schreb.

K. virginica (L.) Willd. Dwarf dandelion. Dry shaly hillsides, in fields and woods; infrequent, in the Hudson and Harlem Valleys. Unknown elsewhere. West Ghent, *1113;* 1 mile southwest of Clermont, *3264;* 2 miles southeast of Churchtown, *3515;* reported from Copake Falls, Stetson (1914).

3. **Tragopogon** L.

T. pratensis L. Goat's beard. Roadsides and waste ground; frequent.

4. **Taraxacum** Wiggers

1. Leaves coarsely and shallowly pinnatifid; heads 3 to 5 cm. broad; achene olive-green or brownish *T. officinale*

1. Leaves deeply and sharply pinnately cut; heads 2 to 3 cm. broad; achene bright red or red-brown *T. erythrospermum*

T. officinale Weber. Dandelion. Lawns, cultivated grounds, moist fields and woods; a very common weed.

T. erythrospermum Andrz. Red-seeded dandelion. Woods and shaded banks; infrequent. Kinderhook, *664.*

5. **Sonchus** L. Sow-thistle

1. Plants perennial, with creeping rootstocks *S. arvensis*

1. Plants annual *S. oleraceus*

S. arvensis L. Waste places, in moist soil; frequent along the Hudson River. Perhaps only the following variety in our area. [var. **glabrescens** Guenth., Grab. & Wimm. Stuyvesant, *4049;* Greendale, *Mrs. H. Livingston* in 1937.] Differs from the typical variety in having the involucres and peduncles glabrous, not glandular-setose; a dangerous weed in some areas.

S. oleraceus L. Waste places around dwellings; locally abundant.

6. **Lactuca** L.

1. Leaves glabrous; flowers pale yellow; pappus white *L. canadensis*
1. Leaves nearly glabrous; flowers pale blue; pappus tawny *L. biennis*

L. canadensis L. Wild lettuce. Moist grounds; frequent, but rather local. Copake Falls, *Britton et al.* (NY); 2 miles south-southwest of Green River, *3527;* 1 mile southwest of West Ghent, *3293;* Forest Lake, *2061;* 2 miles south of Germantown, *3326.*

L. biennis (Moench) Fern. Blue lettuce. Moist or swampy grounds; frequent. Austerlitz, *3822;* 2.5 miles east of Chatham Center, *3682;* Stuyvesant, *House 13306;* Kinderhook, *2157;* Columbiaville, *3727.*

7. **Hieracium** L.

1. Plants scapose, the leaves chiefly basal, *2*
  2. Flowers orange *H. aurantiacum*
  2. Flowers yellow, *3*
    3. Scapes bearing 1 to 4 heads; leaves white-tomentose beneath *H. Pilosella*
    3. Scapes bearing several to many heads; leaves not tomentose beneath, *4*
      4. Plant with slender creeping rootstocks and a few elongated stolons; inflorescence rather dense *H. pratense*
      4. Plants with short stout rootstocks and without elongated stolons; inflorescence loose, *5*
        5. Leaves glaucous, not purple-veined, oblanceolate or spatulate, rather narrow *H. florentinum*
        5. Leaves usually purple-veined above, obovate or elliptic-oblong, often conspicuously broadened *H. venosum*
1. Plants with leafy stems, *6*
  6. Heads 2.5 to 4.5 cm. broad; leaves coarsely toothed *H. canadense*
  6. Heads 1 to 2.3 cm. broad; leaves remotely toothed or subentire, *7*
    7. Plant essentially glabrous (except at base), slender; leaves lanceolate, acute, few-toothed *H. paniculatum*
    7. Plant rough-hairy, stout; leaves elliptic to spatulate-obovate, obtuse, subentire *H. scabrum*

H. canadense Michx. Dry fields and woods, in rocky or sandy soil; infrequent, in the eastern part of the area. 2 miles east of Austerlitz, *3820;* 2 miles south of Canaan, *3596*; [Stephentown Center, *House 21673*].

H. paniculatum L. Dry woods, often in acid soil; common, especially eastward, over schistose and quartzitic rocks.

H. scabrum Michx. Dry fields and open hillsides; infrequent. Austerlitz, *2284;* Kinderhook, *3829;* Nutten Hook, *2216;* seen also about 2 miles north of Jackson Corners, in Gallatin.

H. venosum L. Rattlesnake weed. Dry woods and clearings, in sandy or gravelly soil; common.

H. florentinum All. King devil. Dry soil along roadsides, in fields and in waste grounds; frequent. Kinderhook Lake, *Muenscher 4763* (CU).

H. Pilosella L. Dry fields; occasional, in patches. Curtis Mountain, *House 21479;* North Chatham, *House 21321;* Kinderhook Lake, *905;* 1 mile north of Kinderhook, *782* (PENN).

H. pratense Tausch. Hawkweed. Fields and roadsides, in dry or sterile soil, often a persistent weed in pastures and old fields; common.

H. aurantiacum L. Orange hawkweed. Situations similar to the preceding species and usually growing with it; common. Not reported from our area before 1889 (see Bull. Torrey Bot. Club 16: 136. 1889).

8. **Prenanthes** L.

1. Principal involucral bracts 6 to 8; flowers 8 to 12 in a head, *2*
   2. Pappus deep reddish brown — *P. alba*
   2. Pappus whitish or brownish white — *P. trifoliolata*
1. Principal involucral bracts 5; flowers 5 to 6 in a head — *P. altissima*

P. alba L. Lion's foot. Dry banks, woods and swamps, in rich soil; common. Rare or absent in regions of prevailingly acid soil.

P. trifoliolata (Cass.) Fern. Moist woods; apparently frequent. Copake Falls, *Britton et al.* (NY); Brace Mountain, *4484;* Stuyvesant Falls, *2026;* North Chatham, *4006.*

P. altissima L. Moist rich woods; infrequent or poorly known. No Bottom Pond, *1964*; Copake Falls, *Britton et al.* (NY); Poelsburg, *2256* (PENN); Columbiaville, *4038;* [Claverack, *Rev. A. P. Van Gieson* (V)].

9. **Iva** L. "Marsh elder"

I. xanthifolia Nutt. Weed in waste grounds; rare. Chatham, in a barnyard, *Muenscher 4765* (CU).

10. **Ambrosia** L.

1. Leaves deeply 3-lobed, opposite — *A. trifida*
1. Leaves bipinnatifid, much dissected, in part alternate — *A. artemisiifolia*

A. trifida L. Great ragweed. Moist, usually alluvial soil along the larger streams; common along the Hudson River, often forming dense thickets of some extent; less abundant eastward along Kinderhook Creek and Roeliff Jansen Kill. Kinderhook, *2086;* Cheviot, *2828.*

A. artemisiifolia L. Common ragweed. Fields, roadsides and waste grounds; a common weed.

11. **Xanthium** L.

X. orientale L. Cocklebur. Moist or cultivated grounds and in waste places; common. In the Hudson Valley the abundant phase of the cocklebur is that with hairy burs. The correct name of this plant is uncertain; see the discussion by Wiegand and Eames (1926), and a recent discussion by Fernald (Rhodora 48: 66-74. 1946).

12. **Vernonia** Schreb.

V. noveboracensis (L.) Michx. Ironweed. Wet meadows and swamps; abundant at one locality at Madalin, *2881,* and southward in the Hudson Valley.

13. **Eupatorium** L.[1]

1. Flowers white; leaves opposite, *2*
   2. Leaves united at base around the stem (connate-perfoliate) — *E. perfoliatum*
   2. Leaves separate, sessile or petioled, *3*
      3. Leaves sessile, rounded at base — *E. sessilifolium*
      3. Leaves long-petioled — *E. rugosum*
1. Flowers purplish or flesh-colored, sometimes pale; leaves whorled, *4*
   4. Florets 9 to 15, scarcely exserted; stem usually solid, decidedly pubescent, not glaucous — *E. maculatum*[1]

[1] The purple-flowered species of *Eupatorium,* known as Joe Pye weeds, are treated here as suggested by Wiegand and Weatherby (Rhodora 39: 297-306. 1937); see also Mackenzie (Rhodora 22: 157-165. 1920).

4. Florets 3 to 7 (rarely 8), *5*
5. Stem purple and plainly glaucous, hollow; florets scarcely exserted, the corolla 5 mm. long or less *E. fistulosum*
5. Stem usually green with purple nodes, solid, scarcely glaucous; florets strongly exserted beyond the pale bracts, the corolla more than 5 mm. long *E. purpureum*

E. maculatum L. Wet or moist soil, in open swampy meadows, along streams and in ditches; common. Especially abundant in the swamps along the Hudson River, where it forms a conspicuous element of the flora. New Lebanon, *House 15603;* 2 miles east of Austerlitz, *3821;* Kinderhook, *1972;* Stuyvesant, *House 13307.*

E. fistulosum Barratt. Thickets, edges of woods, borders of ponds and streams, in rather moist soil; frequent in the Hudson Valley, but never as abundant as the preceding species. Not reported eastward. 2 miles south of Claverack, *3988;* seen also at Kinderhook.

E. purpureum L. Rich or moist soil, in woods, usually in rather shady places; common, but never very abundant. New Lebanon; Chatham Center; Bashbish Falls; Kinderhook; Stuyvesant Falls; Tivoli.

E. sessilifolium L. Dry rocky hillsides; rare. Limestone talus, 3 miles north of Claverack, *1300;* thin soil on acid rocks, Cedar Mountain, Copake, *3570;* [Risedorph Hill, Pine Plains, *House 21037,* and reported from the same locality by Hoysradt (1875-79)].

E. perfoliatum L. Boneset. Wet places, usually in open meadows and swamps; common.

E. rugosum Houtt. White snakeroot. Moist woods and thickets; common.

14. **Mikania** Willd.

M. scandens (L.) Willd. Climbing boneset. Swampy woods in the Hudson and Harlem Valleys; frequent in the tidal swamps of the river from Rogers Island southward; rare elsewhere in the southern part of our area. Rogers Island, *2545;* Madalin, along Stony Creek, *2871;* Crugers' Island, *2948;* along Taghkanic Creek, at New Forge, *3478;* 3 miles north of Ancramdale, *1080.* The last locality was known to Hoysradt, who reported the species from a "marsh east of Croghan Hill."

15. **Solidago** L. Goldenrod.

1. Heads in an ample terminal corymbose inflorescence which is flat-topped or nearly so, *2*
2. Leaves narrow, lance-linear, 5 to 13 cm. long; heads in clusters *S. graminifolia*
2. Leaves broader, oval or oblong, the basal 10 to 30 cm. long; heads separate *S. rigida*
1. Heads in a panicle or thyrse, or in axillary clusters, the inflorescence not flat-topped, *3*
3. Involucral bracts strongly squarrose *S. squarrosa*
3. Involucral bracts with erect or appressed tips, *4*
4. Flowers white or cream-colored *S. bicolor*
4. Flowers yellow, *5*
5. Heads in small clusters in the axils of the leaves, at least the lower clusters much surpassed by the subtending leaves; stems glabrous or essentially so, *6*
6. Leaves lanceolate; stem glaucous *S. caesia*
6. Leaves ovate; stem green *S. flexicaulis*

5. Heads in a terminal panicle, *7*
7. Leaves markedly increasing in size down the stem; lower and radical leaves usually present, *8*
8. Heads not at all or scarcely secund on the branches of the terminal thyrsoid panicle, *9*
9. Plants hoary or grayish with soft hairs; involucral bracts obtuse *S. hispida*
9. Plants glabrous or slightly pubescent, *10*
10. Bracts of the involucre linear-subulate, very acute; stem puberulent *S. puberula*
10. Bracts of the involucre oblong or linear-oblong, somewhat obtuse; plants mostly glabrous up to the inflorescence, *11*
11. Inflorescence a dense, very narrow wandlike panicle; plants growing in boggy places *S. Purshii*
11. Inflorescence an ample pyramidal panicle; plants of drier upland soils *S. speciosa*
8. Heads secund on the spreading or recurved branches of the panicle, *12*
12. Leaves glabrous and smooth, or essentially so, *13*
13. Lower leaves lanceolate or oblong-lanceolate, inconspicuously toothed, *14*
14. Branches of the panicle pubescent; panicle narrow; plants growing in boggy places *S. uliginosa*
14. Branches of the panicle glabrous; panicle widely spreading; plants of dry soil *S. juncea*
13. Lower leaves elliptic-oval, sharply and coarsely serrate; branches of panicle pubescent; plants of dry soil *S. arguta*
12. Leaves very scabrous or crisp-puberulent and canescent, *15*
15. Leaves very scabrous to the touch; branches of panicle mostly distant and strongly divaricate *S. patula*
15. Leaves and stems ashy or whitish with close crisp puberulence; panicle not as above *S. nemoralis*
7. Leaves not markedly increasing in size downward; lower and radical leaves usually absent at flowering time, *16*
16. Leaves prominently triple-nerved, elongate, linear to lance-oblong, *17*
17. Stem smooth and glaucous, except in the panicle *S. gigantea*
17. Stem puberulent or hairy, at least above; not glaucous, *18*
18. Involucre 3.2 to 4.5 mm. long; leaves subentire or inconspicuously toothed *S. altissima*
18. Involucre 2 to 2.8 mm. long; leaves sharply toothed *S. canadensis*
16. Leaves with prominent rugose veins, not triple-nerved, *19*
19. Branches of the panicle long and wide-spreading, mostly flowerless toward the base; stem glabrous or puberulent toward the summit *S. ulmifolia*
19. Branches of the panicle floriferous for most of their length; stem villous or rarely glabrous *S. rugosa*

S. squarrosa Muhl. Rocky well-drained slopes, in woods or less often in the open; throughout, usually on shale or schistose rocks, but occasionally on limestone. Frequent and abundant on the shales of the Hudson Valley; infrequent elsewhere. Poelsburg; Alvords' Dock, Stockport; Columbiaville; Valatie, on shale rocks in Kinderhook Creek; Tivoli; 1 mile east of Pulvers Station, Ghent; Robinson Pond, on limestone.

S. caesia L. Blue-stemmed goldenrod. Woods and thickets, in dry or rich soil; common throughout.

S. flexicaulis L. Rich moist soil in woods, or on talus slopes, often in calcareous situations; throughout, in suitable habitats. Very abundant where limestone occurs. Lebanon Springs; 1 mile east of Austerlitz; Canaan Center; Old Chatham; Copake Falls; Stuyvesant Falls; Becraft Mountain.

S. bicolor L. White goldenrod, silver-rod. Dry fields and woods, in rocky or sandy places; common and abundant throughout.

S. hispida Muhl. Dry sandy or stony soil, in fields; infrequent. 1 mile north of Riders Mills, *2199;* 4 miles north of Kinderhook, *2356* (PENN); Old Chatham, *2446* (PENN); 2 miles east of Austerlitz, *3818;* reported from Copake Falls by Taylor (1915). Taylor's report was apparently based upon a specimen collected by Stetson (NY). In our area this plant occurs but sparingly, in fields with *S. bicolor,* and, as has been suggested, may not be distinct from that species.

S. puberula Nutt. Bare rocky summits above 450 m. elevation, on schistose or quartzitic rocks, in the towns of Copake, Ancram and Northeast, extending eastward and southeastward into Massachusetts and Connecticut; occurring rather sparsely on all the peaks in this limited area. Mount Alander, *3794;* east of Boston Corners, *2278;* [Brace Mountain, Northeast, *House* 24797]. Reported from Stissing Mountain by Hoysradt (1875-79).

S. Purshii Porter. Marshes and wet meadows, in calcareous soil; very abundant in the marshes of the Harlem Valley; local elsewhere. Calcareous bog west of Douglas Knob, New Lebanon, *2126;* bog west of Post Road School, Kinderhook, *2262;* Copake Falls, *3914;* 3 miles north of Ancramdale, *3897;* Pulvers Corners, *3848.*

S. speciosa Nutt. Dry shaly hillsides, in fields and thickets; rare. Locally abundant in the Harlem Valley. North of Robinson Pond, *3935;* Risedorph Hill, Pine Plains, *2431* (PENN).

S. rugosa Mill. Thickets, fence rows, borders of woods and in open fields, in dry or moist soil; common.

S. patula Muhl. Rough-leaved goldenrod. Wet woods and swamps, in rich, or calcareous soil; frequent. Present throughout, in suitable situations. 4 miles north of Kinderhook, *2261;* 3 miles north of Ancramdale, *3888;* [Claverack, *Rev. A. P. Van Gieson* (V)]. Seen also at Canaan, Canaan Center, Ghent, Copake Falls and Pulvers Corners.

S. ulmifolia Muhl. Dry rocky woods and slopes, in shaly or calcareous soil; frequent in the Hudson Valley. Not reported from the higher hills eastward and northeastward. Brainard; Kinderhook Lake; Nutten Hook; Alvords' Dock, Stockport; 3 miles north of Claverack; Canaan Center; Blue Hill; 1 mile east of Pulvers Station, Ghent; Pine Plains.

S. uliginosa Nutt. Grassy calcareous marshes; rare. Pulvers Corners, *4456.*

S. juncea Ait. Early goldenrod. Dry fields and woods, in various soils; common. Beginning to flower in June, before any other species of *Solidago.* Often taking over whole fields and pastures in poor or sterile soils, and becoming, with *S. nemoralis,* a persistent weed.

S. arguta Ait. In woods, in rich or rocky soil; common, throughout. An upland plant which can stand considerable shade; it is more tolerant of shade than either *S. squarrosa* or *S. ulmifolia.*

S. canadensis L. Rich soil in woods and by roadsides; in our area known only from a roadside 2 miles west of Stuyvesant Falls, in clay soil, *3834.*

S. gigantea Ait. Wet or moist soil along streams and ditches, in open grassy swamps and around ponds; frequent.

S. altissima L. Tall goldenrod. Fields, roadsides and thickets, in dry or moist soil; common. Often very abundant and conspicuous, through the month of September, along roads and fences and in old fields.

S. nemoralis Ait. Gray or field goldenrod. Fields, open hillsides and rocky or dry woods; common. Especially abundant in old fields, in sandy soil, where it becomes a weed.

S. rigida L. Dry shaly hillsides; locally abundant in the lower part of the Hudson Valley and in the Harlem Valley. Blue Hill, *2165;* Mount Merino, *2309;* Robinson Pond, Copake, *3937.* The Copake locality was perhaps known to Peck (see 31st Report N. Y. State Mus. p. 52. 1879). Reported by Hoysradt (1875-79) from Risedorph Hill, Pine Plains, but search at that locality has failed to reveal it.

S. graminifolia (L.) Salisb. Narrow-leaved goldenrod. Fields, roadsides, pastures and open grassy swamps; common.

16. **Sericocarpus** Nees

S. asteroides (L.) BSP. Dry woods and fields; frequent, usually in acid soils. 4 miles north of Kinderhook; Forest Lake; Long Pond, Ancram; Tivoli; 2 miles southeast of Churchtown; Brace Mountain; Pine Plains.

17. **Aster** L.

1. Leaves, at least the lowest ones, cordate and petioled, *2*
- *2.* Stem leaves mostly cordate-clasping — *A. undulatus*
- *2.* Stem leaves petioled or sessile, not clasping, *3*
  - *3.* Heads in a corymbose inflorescence, *4*
    - *4.* Involucre and peduncles pubescent but not glandular; rays white, *5*
      - *5.* Involucre 4 to 6 mm. long; tufted basal leaves few or none — *A. divaricatus*
      - *5.* Involucre 7 to 9 mm. long; large tufted basal leaves abundant — *A. Schreberi*
    - *4.* Involucre and peduncles minutely glandular-pubescent; rays lavender or rarely white — *A. macrophyllus*
  - *3.* Heads paniculate; rays bluish lavender; leaves slightly scabrous above, slightly or not at all wing-petioled — *A. cordifolius*

1. None of the leaves at once cordate and petioled, *6*
- *6.* Leaves clasping by a cordate base, *7*
  - *7.* Leaves elongate, very inconspicuously clasping; rays white or whitish — *A. simplex*
  - *7.* Leaves evidently clasping, often strongly so; rays violet or purple, *8*
    - *8.* Plant wholly glabrous and glaucous — *A. laevis*
    - *8.* Plants neither wholly glabrous nor glaucous, *9*
      - *9.* Peduncles covered by stipitate glands — *A. novae-angliae*
      - *9.* Peduncles not stipitate-glandular, *10*
        - *10.* Leaves contracted below the middle and again dilated at base, strongly serrate — *A. prenanthoides*
        - *10.* Leaves not as above, *11*
          - *11.* Leaves entire, with rough-ciliate margins — *A. patens*
          - *11.* Leaves, at least the lower, serrate — *A. junciformis*
- *6.* None of the leaves cordate-clasping, *12*
  - *12.* Bracts of the involucre with green tips, *13*
    - *13.* Bracts of the involucre spreading-tipped, bristly-ciliate; plants pale-hoary with minute close pubescence — *A. ericoides*
    - *13.* Bracts of the involucre all appressed, *14*
      - *14.* Upper leaves and involucral bracts with definite firm subulate tips — *A. pilosus*
      - *14.* Upper leaves and involucral bracts without subulate tips, *15*
        - *15.* Rays violet or rose-pink (seldom white); involucre more than 5 mm. high — *A. junciformis*

15. Rays white or barely purple-tinged; involucre 5 mm. high or less, *16*
16. Heads in more or less 1-sided racemes; rays mostly 7 to 14 *A. lateriflorus*
16. Heads on ascending-paniculate branches; rays mostly 14 to 50 *A. simplex*
12. Bracts of the involucre without green tips, *17*
17. Leaves linear; rays violet *A. linariifolius*
17. Leaves lanceolate or broader; rays white, *18*
18. Leaves coarsely and sharply toothed *A. acuminatus*
18. Leaves entire or with minutely ciliate-serrate margins, *19*
19. Involucre 3 to 5 mm. long; leaves lanceolate to ovate *A. umbellatus*
19. Involucre 5 to 7 mm. long; leaves, at least the lower, obovate *A. infirmus*

A. divaricatus L. White wood aster. Dry soil, in woods and thickets; common throughout.

A. Schreberi Nees. Woodlands, often in dry soil; frequent, especially about the margins of woods. Apparently throughout, although not well known from the northeastern part of our area. East Nassau, *House 23967;* 2 miles east of Chatham Center, *3681;* Columbiaville, *3722;* Hudson, *1600;* Copake Falls, *Britton et al.* (NY).

A. macrophyllus L. Dry woodlands, in dry or stony, often acid soil; frequent. Rather abundant eastward, in the acid soils over schistose rocks; infrequent or rare in the Hudson Valley. East Nassau, *House 24229;* Perry Peak, Canaan, *3652;* 3 miles south of Kinderhook, *2291;* Forest Lake, *2049;* 1 mile east of Pulvers Station, Ghent, *2348;* 3 miles south of Boston Corners, *3411;* Brace Mountain, Northeast, *4483.*

A. cordifolius L. Blue wood aster. Woods, thickets, fence rows and roadsides, in moist or dry soil; common. Often very abundant and showy.

A. undulatus L. Dry sandy or stony soil; woods, roadsides and open banks; common throughout. Found everywhere, but never very abundant.

A. patens Ait. Dry hillsides and open banks, in sandy or stony soil; frequent in the Hudson and Harlem Valleys, but not reported northeastward. Kinderhook, *2364;* Ghent, *191* (PENN); Alvords' Dock, Stockport, *2232;* Blue Hill, *2177;* 1 mile south of Germantown, *3959.*

A. novae-angliae L. New England aster. Fields and pastures, edges of woods and swamps; common in the Hudson Valley, and especially abundant on the clay soils near the river. Not seen eastward at elevations greater than 300 m.

A. puniceus L. Purple-stemmed swamp aster. Wet places, in swampy woods, open grassy marshes and roadside ditches; common throughout.

A. prenanthoides Muhl. Moist soil along streams, or in rich woodlands; infrequent. Locally abundant eastward, and somewhat less so in the Hudson Valley. Lebanon Springs, *2397;* 1 mile north of Austerlitz, *4519;* Arnolds' Mills, Ghent, *4517;* Schodack Island, *House 24191;* Stuyvesant Falls, *2036.*

A. laevis L. Smooth aster. Dry fields, banks and roadsides; very common in the Hudson Valley, and especially abundant on the clays and shales near the river. Occurs in the Harlem Valley, but unknown northeastward.

A. junciformis Rydb. Northern bog aster. "Columbia County," according to House (1924). Otherwise unknown.

A. lateriflorus (L.) Britt. Fields, thickets and grassy swamps, and along streams, in moist or dry soil; common.

A. ericoides L. Open fields, pastures and thickets, in dry clay or sandy soils; frequent in the Hudson Valley and probably elsewhere. East Nassau, *House 24234;* Kinderhook, *2361;* Stuyvesant, *4060;* Mount Merino, *2433.*

A. simplex Willd. Wet meadows, open swamps and borders of woods; common. Occurs abundantly in and near the tidal marshes along the Hudson River.

A. pilosus Willd. Open fields and hillsides, in dry sandy or rocky soil, or less often in woods and near streams; common and abundant in the Hudson Valley; occurs in the Harlem Valley, but unknown northeastward. The prevailing phase of the species here is the var. **demotus** Blake.

A. linariifolius L. Dry rocky or sandy banks, or in woods; rare. Copake Falls, *Britton et al.* (NY); rocky (schistose) summit of Mount Fray, at an elevation of about 450 m., *2643;* sandy bank above the Hudson River at Tivoli, *2808.*

A. acuminatus Michx. Mountain aster. Rocky woods, in acid soil; also in sphagnum bogs; abundant in clearings. Common eastward, at elevations of more than 300 m. Rare and local in the Hudson Valley: 2 miles south of Claverack, *3996;* Tivoli, *2987.*

A. umbellatus Mill. Wet woods, sphagnous swamps, pastures and rocky clearings, often in acid soil; widely distributed but very local. Kinderhook, in open sedgy swamps, *1980;* 2 miles south of Claverack, in moist clay soil in woods, *3997;* common and abundant in wet places along the trails on the higher hills in the towns of Copake, Ancram and Northeast.

A. infirmus Michx. Dry sandy or shaly banks and woodlands; frequent in the Hudson and Harlem Valleys. Valatie; Kinderhook Lake; Alvords' Dock, Stockport; 1 mile east of Pulvers' Station, Ghent; Forest Lake; Long Pond, Ancram; Copake Falls.

18. Erigeron L. Fleabane

1. Ray flowers much exceeding the disk, conspicuous, *2*
- *2.* Heads large, 2.5 to 3.5 cm. in diameter; rays about 50, 1 mm. wide, light bluish purple — *E. pulchellus*
- *2.* Heads usually 1.5 to 2 cm. in diameter; rays less than 1 mm. wide, *3*
  - *3.* Rays very numerous (100 to 150), pinkish; cauline leaves clasping — *E. philadelphicus*
  - *3.* Rays 50 to 75, white; cauline leaves narrowed and not clasping at base, *4*
    - *4.* Leaves coarsely and sharply toothed; pubescence scattered, spreading — *E. annuus*
    - *4.* Leaves entire or nearly so; pubescence appressed — *E. strigosus*

1. Ray flowers very short, scarcely if at all exceeding the disk, inconspicuous; heads very numerous and small, panicled — *E. canadensis*

E. pulchellus Michx. Rich woods, in moist or rocky soil, often in calcareous situations; rather frequent. New Lebanon, *House 21300;* New Forge, *3474;* Robinson Pond, *3944;* 3 miles north of Ancramdale, *3336;* 1 mile north of Kinderhook, *653.*

E. philadelphicus L. Moist pastures and woods and along streams; frequent. Abundant and conspicuous in soil pockets and crevices in the shales, near the water, along the Hudson River and the larger creeks.

E. annuus (L.) Pers. Fields, pastures and waste places; common and weedy.

E. strigosus Muhl. Situations similar to the preceding species; common and weedy.

E. canadensis L. Fireweed, horseweed. Woods, fields, cultivated grounds and waste places; a common weed.

19. **Antennaria** Gaertn. Cat-feet; Indian tobacco

1. Rosette leaves comparatively small, 0.2 to 2.1 cm. wide, with only one vein (the midvein) prominent to the tip; lateral veins short or wanting, *2*
  2. Middle and upper cauline leaves terminated by a flat or merely involute scarious appendage; rosette leaves mostly oblanceolate, subacute, *3*
    3. Basal leaves, especially those of the stolons, dull and more or less hairy above; stolons long-creeping, with much reduced leaves, the apical leaves later enlarging *A. neglecta*
    3. Basal leaves, especially those of the stolons, bright green and glabrous above; stolons usually comparatively short, leafy, forming dense mats *A. canadensis*
  2. Middle and upper cauline leaves sublate-tipped or mucronate, without a scarious appendage; rosette leaves mostly spatulate or obovate, rounded and mucronate at tip, dull and more or less hairy, especially those of the stolons *A. neodioica*
1. Rosette leaves comparatively large, 0.7 to 5.5 cm. wide, with 3 to 7 somewhat prominent long veins beneath; middle and upper cauline leaves with firm subulate tips, *4*
  4. Rosette leaves, at least those of the stolons, dull and hairy above, *5*
    5. Pistillate involucre 5 to 7 mm. high *A. plantaginifolia*
    5. Pistillate involucre usually 8 to 11 mm. high, *6*
      6. Rosette leaves rhombic-ovate, narrowed from near the middle to the subacute or blunt tip *A. fallax*
      6. Rosette leaves spatulate to narrowly spatulate-obovate, rounded at apex *A. munda*
  4. Rosette leaves, especially those of the stolons, bright green and glabrous above *A. Parlinii*

A. canadensis Greene. Dry fields and pastures, in sandy or stony soil; common. Usually associated with *A. neglecta, A. neodioica,* or both.

A. Parlinii Fern. Wooded slopes and roadside banks, often in rich or calcareous soil; rather frequent, but local. Stuyvesant (PENN); Kinderhook; Tackawasick Lake; 1.5 miles north of Queechy Lake; 3 miles north of Claverack (PENN); Mount Merino; Livingston.

A. munda Fern. Gravelly or rocky soil, usually in dry woods, but sometimes in moist places; frequent throughout. Common in the Hudson Valley.

A. fallax Greene. Poorly known, but apparently throughout, in situations like the preceding species. Kinderhook, *4248.*

A. plantaginifolia (L.) Hook. Dry woods and fields, often in stony soil; common throughout. Abundant on shales and schistose rocks.

A. neglecta Greene. Dry fields, pastures and open woods, in poor or stony soil; common. Often very abundant in old fields and pastures.

A. neodioica Greene. In situations with the preceding species; common.

20. **Anaphalis** DC.

A. margaritacea (L.) B. & H. Pearly everlasting. Dry fields and edges of woods; common.

21. **Gnaphalium** L.

1. Plants tall, erect, 30 to 90 cm. high; herbage fragrant when crushed; heads about 5 mm. high, *2*
  2. Leaves lanceolate, tapering at base, not decurrent *G. obtusifolium*
  2. Leaves linear-lanceolate, with a clasping base, the margin decurrent on the stem *G. Macounii*
1. Plants low, diffuse or nearly prostrate, rarely more than 30 cm. high; herbage not or scarcely fragrant; heads about 2 mm. high *G. uliginosum*

G. obtusifolium L. Sweet everlasting. Dry fields and edges of woods; common and often somewhat weedy.

G. Macounii Greene. Sweet everlasting. Fields and roadsides; infrequent, usually appearing as if introduced. East Nassau, *House 21949;* Kinderhook, *2351;* south of Pine Plains, *House 21057;* Hudson, according to Stebbins (1830).

G. uliginosum L. Wet places; often in ditches and along roadsides; frequent.

22. Inula L.

I. Helenium L. Elecampane. Dry fields and roadsides; locally abundant. New Lebanon; Canaan; widely distributed in the clay soils of the Hudson Valley.

23. Heliopsis Pers.

H. helianthoides (L.) Sweet. False sunflower. Moist banks of streams; common along the Hudson River and locally abundant along the large creeks in the Hudson Valley; unknown elsewhere. Poelsburg; Stuyvesant; Stockport; Hudson; Germantown; Tivoli; Kinderhook.

24. Rudbeckia L.

1. Disk of flowering heads greenish yellow; stem smooth *R. laciniata*
1. Disk of flowering heads brownish or dark purplish brown; stems rough-haired, *2*
  2. Leaves, at least some of them, 3-lobed or 3-parted; chaff of receptacle awned, smooth *R. triloba*
  2. Leaves entire or nearly so; chaff subacute, hairy at the tip *R. hirta*

R. triloba L. Coneflower. Various situations, in dry or moist soil; infrequent, but locally abundant. Usually along roadsides, where evidently introduced, but sometimes along streams and near lakes, where appearing to be indigenous. Poelsburg, at edge of tidal mud, *2373;* Kinderhook Lake, *House 11307;* 2 miles east of Germantown, *2919;* 1 mile south of Madalin, *2880.*

R. hirta L. (incl. *R. serotina* of *Gray's Manual*). Black-eyed Susan. Meadows and fields, or in light shade; common and weedy.

R. laciniata L. Coneflower. Swamps and along streams; common. The common Golden Glow of gardens is a form of this species.

25. Helianthus L. Sunflower

1. Disk dark brown or purple; leaves narrowly linear, often 25 to 50 times as long as wide *H. salicifolius*
1. Disk yellow or light brown, *2*
  2. Leaves elongated-lanceolate, the upper ones alternate, not 3-nerved *H. grosseserratus*
  2. Leaves opposite, 3-nerved, mostly ovate-lanceolate, *3*
    3. Leaves sessile or nearly so, with a broad base *H. divaricatus*
    3. Leaves tapering to an acute base or to a petiole, *4*
      4. Leaves rough, whitish beneath, very indistinctly toothed *H. strumosus*
      4. Leaves green beneath, coarsely serrate, *5*
        5. Stem hirsute-pubescent; rootstocks tuberous-thickened; rays 12 to 20, deep yellow *H. tuberosus*
        5. Stem smooth below; rootstocks not thickened but creeping; rays about 10, light yellow *H. decapetalus*

H. salicifolius A. Dietr. Niverville, *House 13399.* Otherwise unknown.

H. grosseserratus Martens. Abundant in a small water-filled depression south of Mount Merino, *2434.* Otherwise unknown.

H. divaricatus L. Dry woods and open rocky hillsides; common throughout.

H. decapetalus L. Woods and banks of streams; frequent, usually in rich or moist soil.

H. strumosus L. Dry woods and thickets; infrequent, but widely distributed and locally abundant. Poelsburg, *2258;* 1 mile north of Kinderhook, *2300;* Columbiaville, *4048;* Lebanon Springs, *2399;* Copake Falls, ***Britton et al.*** (NY).

H. tuberosus L. Jerusalem artichoke. In and around old yards and gardens; occasionally established.

26. Bidens L.

1. Plants aquatic, mostly submerged; submerged leaves finely dissected; ray flowers showy, golden yellow *B. Beckii*

1. Plants terrestrial; leaves not finely dissected, *2*

  2. Ray flowers showy, much exceeding the disk; leaves sessile, connate at base; fruiting heads often drooping; disk-flowers never reddish *B. cernua*

  2. Ray flowers small or wanting, rarely exceeding the disk, *3*

    3. Leaves pinnate, with 3 to 5 leaflets, *4*

      4. Outer involucre of 5 to 8 leafy bracts; achenes 2 to 3.3 mm. broad *B. frondosa*

      4. Outer involucre of 10 to 16 leafy bracts; achenes 3.3 to 4 mm. broad *B. vulgata*

    3. Leaves simple, some of the lower sometimes deeply parted, *5*

      5. Margins of the achenes downwardly barbed for their entire length, *6*

        6. Summit of the achene convex and cartilaginous *B. hyperborea*

        6. Summit of the achene not convex and cartilaginous *B. comosa*

      5. Margins of the achene upwardly barbed, at least at the very base, *7*

        7. Terminal heads with 8 to 30 flowers, *8*

          8. Achenes without midribs; awns at least half as long as the body of the achene *B. bidentoides*

          8. Achenes with conspicuous midribs; awns not more than one-third as long as the body of the achene *B. Eatoni*

        7. Terminal heads with 30 to 60 flowers *B. connata*

B. cernua L. Wet places; ditches, borders of lakes and ponds, open grassy marshes; common throughout. Very abundant in calcareous marshes, where it makes a striking display in mid-September. It is also a conspicuous element of the flora of the tidal marshes of the estuary. The very similar *Bidens laevis* (L.) BSP., with reddish disk-flowers, is reported by Svenson (1935) from Stony Creek.

B. connata Muhl. Ditches, stream banks and wet places around springs and ponds; common in the Hudson Valley. Most abundant in the tidal marshes, but much less conspicuous than the preceding species. Not reported eastward.

B. comosa (Gray) Wieg. Wet shores of lakes; apparently infrequent. Kinderhook Lake, *Peck;* Tackawasick Lake, *House 24242.*

B. frondosa L. Pitchforks, Spanish needles. Wet or moist soil, near ponds and streams; common, often becoming a troublesome weed in cultivated and waste grounds.

B. vulgata Greene. Pitchforks, Spanish needles. Ditches, roadsides and cultivated grounds; locally very abundant. Niverville; Kinderhook; Copake Falls; [Claverack].

B. hyperborea Greene. In tidal mud along the Hudson River, where frequent; an estuarine species unknown elsewhere in our area. Mouth of the

Muitzes Kill, *House 24209;* Rogers Island, *4472;* mouth of Stony Creek, according to Svenson (1935).

B. bidentoides (Nutt.) Britt. Habitat of the preceding species; there common and abundant. New Baltimore, *House 24286;* Nutten Hook, *4055;* Hudson, according to Svenson (1925); mouth of Stony Creek, according to Svenson (1935).

B. Eatoni Fern. Habitat of the two preceding species; there frequent. Mouth of the Muitzes Kill, *House 24202;* Nutten Hook, *4514;* Hudson, *Svenson* (GH); mouth of Stony Creek, according to Svenson (1935). The Hudson River material seems all to conform to var. **major** Fassett; Svenson's collection from Hudson was cited by Fassett (1925).

B. Beckii Torr. (*Megalodonta Beckii* of *Gray's Manual*). Water marigold. In water around the margins of lakes and ponds; rare. Rather abundant at Waldorf Pond, *House 21751;* Pine Plains, *Peck.*

27. **Galinsoga** R. & P.

1. Peduncles and stems near the nodes clothed with coarse spreading white stiffish hairs intermixed with glandular hairs *G. ciliata*

1. Peduncles and stems near the nodes with appressed soft hairs, these usually not glandular *G. parviflora*

G. parviflora Cav. Waste and cultivated grounds; locally abundant as a weed, but apparently much less frequent than the following species. Stockport Creek, above Columbiaville, *4494.*

G. ciliata (Raf.) Blake. Waste and cultivated grounds; locally abundant as a weed, and rapidly spreading.

28. **Helenium** L.

H. autumnale L. Sneezeweed. Tidal swamps and along creeks; common along the Hudson River, and infrequent along streams in the Hudson Valley as far east as Glenco Mills. 3 miles north of Castleton, *3968;* Poelsburg, *2374;* 2 miles east of Germantown, along Roeliff Jansen Kill, *2916;* Cheviot, *2819;* 2 miles west of Nevis, *2892;* [Claverack, *Rev. A. P. Van Gieson* (V)].

29. **Achillea** L.

A. Millefolium L. Yarrow. Fields, roadsides and woods; common and often weedy.

30. **Anthemis** L.

1. Rays white; plant strong-scented; heads 2.5 cm. broad *A. Cotula*

1. Rays yellow; heads 3 to 4 cm. broad *A. tinctoria*

A. Cotula L. Fetid camomile. Cultivated grounds; dooryards and waste places; a common weed.

A. tinctoria L. Cultivated; collected once, as an escape, near Kinderhook, *1063* (PENN).

31. **Matricaria** L.

M. matricarioides (Less.) Porter. Roadsides and waste places; a common weed.

32. **Chrysanthemum** L.

C. Leucanthemum L. Ox-eye daisy. Fields and roadsides; a common weed. Represented in our area by var. **pinnatifidum** Lecoq & Lamotte.

33. **Tanacetum** L.

T. vulgare L. Tansy. Roadsides, old yards and along streams; common but local. Forming large patches where established.

34. **Tussilago** L.

T. Farfara L. Coltsfoot. Moist places along roadsides and streams, usually in clay soil; frequent. Most abundant on the clays of the Hudson Valley.

35. **Erechtites** Raf.

E. hieracifolia (L.) Raf. Fireweed. Woods and swamps, especially in clearings; frequent throughout.

36. **Senecio** L.

1. Plants perennial; rays present, *2*
  2. Lowest leaves obovate, or occasionally subrotund or oblong, gradually narrowed into a narrowly winged petiole *S. obovatus*
  2. Lowest leaves broad-ovate, deeply cordate, long-petioled *S. aureus*
1. Plants annual; rays none *S. vulgaris*

S. aureus L. Golden ragwort. Wet places, in pastures and rich or swampy woods; frequent, but rather local. Lebanon Springs, *Harrison* (US); New Britain, *4311* (GA); North Chatham, *4009;* Kinderhook, *667;* Rogers Island, *2547.*

S. obovatus Muhl. Shaly or calcareous hillsides and outcrops; frequent, especially eastward. Infrequent or rare in the Hudson Valley. Lebanon Springs, *Harrison* (US); Mount Lebanon, *House 16154;* Washburn Mountain, Copake, *3459;* 3 miles north of Ancramdale, *3337;* Millerton, *House 22417;* Blue Hill, *611* (PENN).

S. vulgaris L. Groundsel. Garden weed in Hudson, *5101* (USNA); reported from Pine Plains by Hoysradt; otherwise unknown.

37. **Arctium** L.

1. Heads subcorymbose, 3 to 5 cm. broad *A. Lappa*
1. Heads racemose or subracemose, 1.5 to 3 cm. broad *A. minus*

[**A. Lappa** L. Great burdock. Moist soil in waste ground; rare. Millerton, *Peck;* observed at Mount Lebanon by House].

A. minus (Hill) Bernh. Common burdock. Moist soil in waste places, roadsides, thickets and open woods; common and weedy.

38. **Cirsium** Mill. Thistle

1. Heads numerous, small, 2.5 cm. in diameter or less; involucral bracts spineless or the outer ones barely prickly-pointed; plants with extensively creeping rootstocks *C. arvense*
1. Heads larger, 3 cm. or more in diameter; plants without creeping rootstocks, *2*
  2. Bracts of the involucre all tipped with spreading prickles; leaves decurrent, woolly beneath *C. vulgare*
  2. At least the inner bracts of the involucre soft and spineless; leaves not decurrent, *3*
    3. Leaves matted white-woolly beneath, outer bracts spine-tipped *C. discolor*
    3. Leaves green beneath or sparingly cobwebby, *4*
      4. Heads large, 4 to 8 cm. broad; outer bracts spine-tipped *C. pumilum*
      4. Heads 3 to 4 cm. broad; outer bracts pointed, but not spiny *C. muticum*

C. vulgare (Savi) Tenore. Bull thistle. Fields and pastures; widely distributed but local.

C. discolor (Muhl.) Spreng. Fields, roadsides and alluvial grounds; frequent on the clay soils of the Hudson Valley. Linlithgo, *3963;* [Claverack, *Rev. A. P. Van Gieson* (V)].

C. pumilum (Nutt.) Spreng. Pasture thistle. Fields and pastures; frequent, but never abundant.

C. muticum Michx. Swamp thistle. Swampy woods and open calcareous marshes; frequent. Kinderhook; Canaan Center; Copake Falls; Pulvers Corners; Brainard.

C. arvense (L.) Scop. Canada thistle. Pastures and grain fields, roadsides and cultivated grounds; a common and troublesome weed. A plant collected at Nutten Hook, *1459,* has been referred to var. **integrifolium** Wimm. & Grab.

39. **Centaurea** L.

1. Lower leaves pinnatifid into linear or lanceolate segments; middle and outer involucral bracts with the tips pectinate *C. maculosa*

1. Leaves merely toothed (rarely lobed), not at all pinnatifid; bracts not pectinate, but with abruptly much dilated tips *C. Jacea*

C. maculosa Lam. Knapweed. Roadsides and waste grounds; locally abundant as a weed. Apparently spreading rapidly and becoming common.

C. Jacea L. Roadsides and old fields; locally established, and sometimes very abundant. At Columbiaville it is very abundant over many acres. Also at East Chatham, *Mrs. C. E. Marstens.*

EXCLUDED SPECIES

The following have been reported in literature from the Columbia County area, but none of the reports has been substantiated, and the species and varieties in question have been excluded from the above catalog. Certain reports are known, or thought, to have been based on misidentifications or other errors. Some of the names are not certainly identifiable. When important range extensions have depended upon published records, without verifying specimens, some mention of these individual records has been made in the systematic account. A separate list is given below to include some additional species reported by Hoysradt from the vicinity of Pine Plains.

Botrychium silaifolium
Pinus mitis
Cupressus thyoides
Cupressus distichus
Sparganium simplex var. *fluitans*
Bromus mollis
Glyceria fluitans
Poa debilis
Triticum violaceum
Trisetum palustre
Panicum microcarpon
Panicum columbianum
Panicum xanthophysum
Andropogon virginicus
Cyperus dentatus
Eleocharis Robbinsii
Eriophorum polystachyon var. *paucinervium*
Carex Muhlenbergii var. *enervis*
Carex alopecoidea
Carex sterilis
Carex echinata
Carex tenera var. *major*
Carex adusta
Carex debilis
Carex irrigua
Carex bullata
Carex lupuliformis
Lemna perpusilla
Xyris flexuosa
Lilium superbum
Ixia chinensis
Habenaria bracteata
Cypripedium arietinum
Orchis flava
Habenaria fimbriata
Habenaria orbiculata
Spiranthes Romanzoffiana

Cymbidium hyemale
Saururus cernuus
Populus balsamifera var. *candicans*
Populus heterophylla
Quercus falcata
Quercus palustris
Chenopodium Boscianum
Cerastium semidecandrum
Arenaria stricta
Anemone cylindrica
Ranunculus allegheniensis
Ranunculus bulbosus
Thalictrum purpurascens
Cardamine hirsuta
Ribes prostratum
Prunus americana
Indigofera tinctoria
Desmodium marilandicum
Desmodium obtusum
Ilex laevigata
Sida spinosa
Viola Selkirkii
Epilobium palustre
Hippuris vulgaris
Myriophyllum verticillatum
Conium maculatum
Sium angustifolium
Thaspium aureum
Levisticum officinale
Azalea arborescens
Vaccinium dumosum
Vaccinium frondosum
Lysimachia lanceolata
Asclepias purpurascens
Convolvulus repens
Cuscuta arvensis
Cuscuta Coryli
Monarda didyma
Lycopus rubellus
Veronica agrestis
Gerardia purpurea
Viburnum nudum
Hyoseris amplexicaulis
Hieracium Gronovii
Nabalus Fraseri
Solidago erecta
Solidago thyrsoidea
Solidago odora
Solidago stricta
Aster longifolius
Aster dumosus
Aster novi-belgii
Aster sagittifolius
Aster Tradescanti
Gnaphalium purpureum

The species in the following list were reported by Hoysradt from the vicinity of Pine Plains but have not since been found in the area of the present study:

Triglochin palustris
Festuca tenella
Holcus lanatus
Sporobolus serotinus
Eleusine indica
Panicum glabrum
Panicum filiformis
Paspalum setaceum
Rynchospora fusca
Scleria pauciflora
Muscari botryoides
Habenaria viridis var. *bracteata*
Habenaria virescens
Spiranthes Beckii
Microstylis monophyllos
Aplectrum hyemale
Salix alba var. *vitellina*
Celtis occidentalis var. *crassifolia*
Cannabis sativa
Morus alba
Morus nigra
Polygonum orientale
Cerastium viscosum
Nigella damascena
Papaver somniferum
Corydalis aurea
Fumaria officinalis
Arabis glabra
Cardamine pratensis
Trifolium procumbens
Tephrosia virginiana
Vicia sativa
Geranium carolinianum
Linum usitatissimum
Hypericum canadense
Viola lanceolata
Ammannia humilis
Aethusa Cynapium
Vaccinium corymbosum var. *amoenum*
Ipomoea purpurea
Cynoglossum virginicum
Symphytum officinale
Marrubium vulgare
Lophanthus nepetoides
Blephilia hirsuta
Mentha spicata
Mentha piperita
Leucanthemum Parthenium
Artemisia Absinthium
Onopordum Acanthium

PART 2: GENERAL CONSIDERATION OF THE REGION AND ITS VEGETATION

GEOLOGY OF THE REGION

The topographic lowland which forms the area of the present study is somewhat set off geologically from the rest of southeastern New York. The rocks are mostly sedimentary, of Cambrian and Ordovician age, deposited in the great Appalachian Geosyncline off the west coast of the hypothetical Paleozoic continent, Appalachia. They are thus related geologically to the rocks of the present Appalachian Mountains rather than to those of the Hudson highlands, which are Precambrian crystalline rocks, to those of the Catskills and Helderbergs, which are mostly Devonian in age, or to those of the Adirondacks, which are also Precambrian. The rocks of the Columbia County area of the Hudson Valley are to be thought of as continuous with those of western New England (the Taconic Mountains).

During Cambrian time, especially during the Upper Cambrian, the sea covered most of what is now southeastern New York; this submergence continued during the Cambro-Ordovician interval (Miller, 1913) and during the Ordovician. As a result, considerable strata were deposited during these periods, from sediments washed from the uplands of Appalachia. These strata include Cambrian sandstones, shales and limestones, as well as similar rocks of Ordovician age. At the close of the Ordovician period occurred the Taconic Revolution, which raised the present Taconic Mountains and caused severe metamorphosis, due to intense folding and a series of overthrust faults from east to west.

The orthography of the word "Taconic" has occasioned some discussion. At present the above spelling, being simpler, is largely used in referring to the range of mountains and to the Tri-State Park situated where New York, Massachusetts and Connecticut adjoin. The town and village in Columbia County, however, use the spelling "Taghkanic." Dewey (1818) gives a short discussion of the matter in speaking of the "Taconick" range; according to him, previous usage had sanctioned "Taghconnuc" or "Toghconnuck."

The most severe metamorphosis of the Taconic Revolution was along a line ("Logan's line") passing through our area, running generally N 20° E (Ruedemann, 1930); that is, nearly parallel to the New York-Massachusetts line. West of this hypothetical line, near the Hudson River, the prevailing rocks are nearly unchanged

shales and limestones. The disturbance becomes increasingly more evident eastward, where the prevailing rocks are schists and quartzites.

The periods succeeding the Ordovician have left few traces in the eastern half of the valley of the Hudson River; the Silurian is represented by Manlius limestone and the Devonian by several strata of limestones and shales, all of which are found in our area solely at Becraft Mountain, near Hudson. According to Grabau (1903) Becraft Mountain and a small outlier a few miles to the north are probably isolated remnants of the Helderberg formations of the lower Devonian, which have escaped erosion. Geologically speaking, Becraft Mountain is famous because of the exposures of fossiliferous rocks which occur there; notes concerning it are found at least as early as the fourth volume of Silliman's Journal (Jenkins, 1822), and it has given its name to the limestones of Becraft age.

In the north-central part of Columbia County and extending northward into Rensselaer County is a belt of the much discussed Rensselaer Grit, which is considered to be of Upper Devonian age (Ruedemann, 1930). The Devonian strata are in part undisturbed, but show some folding due to the Appalachian Revolution and uplift at the close of the Paleozoic.

The close of the Paleozoic marks the end of deposition of marine strata in eastern New York. Except for the relatively modern glacial age, the Devonian period was the last in which new rock and soil materials were added in this region. Briefly, then, the strata in the Columbia County area are mainly of Cambrian and Ordovician age, with a strike generally N-S or NNE-SSW. The unchanged sedimentary rocks are shales, sandstones and limestones; all show some folding of strata, brought about by the Taconic Revolution (at the close of the Ordovician) or the Appalachian Revolution (late Paleozoic). Metamorphism becomes gradually more pronounced eastward to the eastern boundary of the region, the shales being replaced by schists and gneisses, the sandstones by quartzite (Dana, 1885) and the limestones by more highly crystalline rocks. In general, metamorphism is evident east of a line marked roughly by the 600-foot (183-meter) contour line.

During most of the Mesozoic, eastern New York stood well above sea level, due to the Appalachian uplift, and peneplanation took place; that is, the streams of that time gradually wore the hills down to a nearly level plain. In late Cretaceous or early Tertiary time (Paleocene, according to Grabau, 1921) the whole Appalachian region,

including the Taconic Range, was lifted bodily through a distance of 2,000 or 3,000 feet (roughly 600 to 900 meters). The level of this ancient uplifted peneplain is now shown by the general level of the tops of the Berkshires (Miller, 1913), the Helderberg and Rensselaer Plateaus (Ruedemann, 1930) and the secondary peaks of the Catskills (Rich, 1935). Following this uplift, the Hudson River cut its course into the rocks of the peneplain and during the progress of the Tertiary Period, established a new grade. After this secondary level had been established, however, a further uplift took place; the valley was again raised bodily some 600 feet (180 meters), and at the close of the Tertiary a second elevated peneplain was thus brought about. This secondary peneplain is discussed by Ruedemann (1930) as the "Albany Peneplane." According to him, it was a broad plain which was about 200 feet (60 meters) above sea level at Albany and which rises slowly to about 600 feet elevation at the foot of the Rensselaer Plateau. This inner peneplain apparently existed at the close of the Tertiary period, which is thought to have been at least two million years ago (Eames, 1936).

During the latter part of Tertiary time the climate of North America was growing progressively colder, and the last major geological change in the Hudson Valley was brought about by the advance of great glacial ice sheets from the north. These ice sheets advanced and receded periodically, with each advance carrying huge amounts of rock and soil scraped up in their passage and depositing a part of this load along the way. The last ice sheet to invade eastern New York, the so-called Wisconsin sheet, is thought to have receded finally about 30,000 years ago. The ice pushed down the river valley in its last advance and seemingly traveled southeastward through Columbia and Berkshire Counties (Taylor, 1903). So far as is known, the glacial ice covered the whole area. Evidence of this is present everywhere in the numerous low rounded hills and the abundant unassorted till (mixed stones, clay and sand, of all descriptions, dropped from the melting ice). The ice sheet is thought to have been near its southern limit at this point, and the till in question is mostly derived from rocks of nearby areas.

The glacier seems to have become stagnant at its maximum extension, and subsequently to have receded northward and northwestward, leaving the lower end of the Hudson Valley blocked by a tongue of unmelted ice which overlapped the rock terraces east of the river (Cook, 1930). It was at this time that the clays and sands of the present valley were brought down by streams and deposited, in part as terrace deltas, against the ice (Woodworth, 1905). As sediments

were brought down it is thought they may have backed up the incoming waters and created many more or less temporary lakes in which additional sands were deposited at various levels (Cook, 1930).

As the glaciers receded and the great weight of the ice sheet was removed from the land, there seems to have been a wavelike uplift of the land in our area (Fairchild, 1919). This amounted to an uplift of 250 to 350 feet (about 75 to 100 meters) in Columbia County. The final great change in the region has taken place since the disappearance of the glacial ice. After the modern streams, including the Hudson River, had established their present courses, the whole valley was depressed somewhat, from Albany southward, allowing the sea to invade the river and the lower parts of the stream valleys and thus making the lower Hudson an arm of the sea (an estuary) (Woodworth, 1905; Cook, 1930).

DESCRIPTION OF REGION

The Columbia County area of the Hudson Valley, including the parts outside of the political boundaries of Columbia County as described above, may be thought of as a rectangle with its longer axis extending nearly north and south. It is divided into two nearly equal parts, not only topographically and geologically but floristically as well, by a line parallel to the long axis. This line roughly approximates that of the 600-foot contour as mapped by the United States Geological Survey (see sketch map, figure 22).

West of this imaginary line the country is relatively flat with a considerable number of meandering or slow streams with well-developed flood plains. There is an abrupt drop of 100 to 200 feet at the Hudson River so that the nearly level valley is terminated at its western edge by cliffs, bluffs or steep wooded slopes above the river, the river itself thus lying in a great trough or inner valley.

The soils of this western part of the area are mostly derived from water-laid sands and clays or from the native sedimentary rocks, and are not strongly acid except on the more sandy types. There are a number of isolated rocky knobs, from 300 to 600 feet (90 to 180 meters) in height, which may represent the remnants of the old Albany Peneplain. The flora of this part of the Columbia County area is made up, for the most part, of species which have their affinities with those of warmer or more southern parts of North America. In the following study, this little-elevated western half of the county will be spoken of as the Hudson Valley. The term is thus restricted to a portion of the "valley" in the larger sense; that is, to

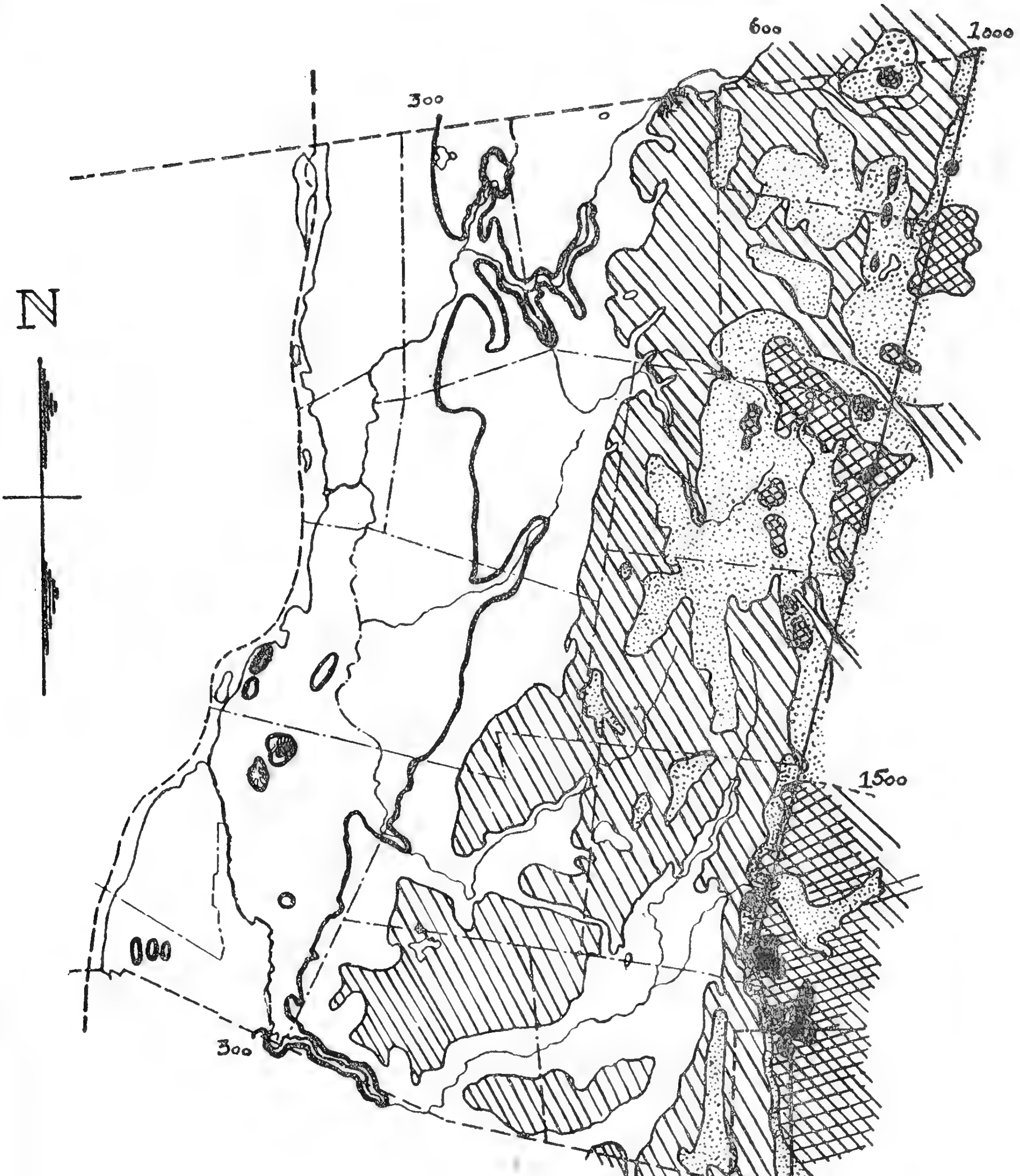

Figure 22. Sketch map of the topography of Columbia County. Hudson River at sea level; elevations shown in feet; areas above 2000 feet elevation shown in solid black. Numerous small isolated elevations are not shown.

a portion of the rising land between the river itself and the summits of the Taconic Mountains. This restriction seems advisable because of the rather sharp line of demarcation which may be drawn between the flora of the Hudson Valley (in the restricted sense) and that of the rest of the area.

As used hereafter, therefore, the term "Hudson Valley" will be used to designate that portion of our area lying west of an irregular line running from the north end of Stissing Mountain and the village of Elizaville to a point about 2 miles north of Nassau Lake. Under

this interpretation the Hudson Valley includes a considerable portion of the town of Taghkanic, in the valley of Taghkanic Creek.

East of the above line (that is, in general, east of the 600-foot contour line), except as noted below, the country presents quite a different aspect. The topography is much more rugged and the streams are smaller, fewer and swifter, with numerous small rapids and falls. Due to the generally hilly land and rocky soils, farming is relatively difficult and much of the land has been abandoned in recent years. Soils are predominantly of the Dutchess series, acid in nature, and influenced to some extent by the underlying rocks which are mostly strongly metamorphosed schists and quartzites. Many of the hills of 1,400 to 1,800 feet (about 425 to 550 meters) elevation appear to be remnants of the early Tertiary peneplain, which have escaped erosion. The flora of this part of the Columbia County area includes many species usually thought of as characteristic of mountainous districts and, to a limited extent, of more northern regions.

The statements in the preceding paragraph are generally true for the half of the Columbia County area that lies east of the Hudson Valley. It should be explained, however, that this more rugged area is much less uniform than the Hudson Valley. The highlands are much dissected by streams, so that a number of deep valleys are formed. In addition to this, considerable strata of Ordovician limestone (Dana, 1887) are exposed along the western side of the Taconic Range. These relatively soluble strata have resisted erosion much less than the harder and less soluble schists and quartzites, with the result that broad valleys have been formed where the limestones are exposed. The most important of these valleys, from our standpoint, is the one which will hereafter be referred to as the Harlem Valley. Beginning in the town of Hillsdale, it runs southward through Copake and Ancram, with its eastern boundary about a mile from the New York-Massachusetts boundary line and terminated abruptly by the precipitous slope of the mountains. In Ancram the valley broadens out and spreads westward to include part of the town of Gallatin and continues southward into Pine Plains and Northeast (see map, figure 22, and soil map, figure 23). It should be noted that the calcareous soils are somewhat more restricted in area than is the actual valley as shown on the topographic map. The Harlem Valley narrows in Dutchess County, and is interrupted by the Hudson Highlands.

In our area the Harlem Valley is occupied by the Roeliff Jansen Kill, which rises in Hillsdale, flows generally southward and southwestward through Copake, Ancram and Gallatin to the Dutchess County line; here it turns westward and follows roughly the boun-

dary between the counties for some miles, north of the great mass of Stissing Mountain (see map, figure 22). Subsequently, upon reaching the Hudson Valley, it turns northwestward and finally flows into the Hudson not far south of where it rises. The Roeliff Jansen Kill occupies a lowland which thus connects the Harlem Valley in the southeastern part of our area with the Hudson Valley farther west. Much of the Harlem Valley is relatively level and closely similar to the Hudson Valley in aspect and in composition of the vegetation. Much of its area is less than 600 feet (180 meters) above sea level and possesses relatively rich soil, so that its vegetation is in striking contrast to that of the rocky hills that rise steeply a thousand feet above it to the eastward.

A second lowland, formed where limestone strata are exposed, lies in the towns of New Lebanon and Canaan. This is a much less striking feature than the Harlem Valley, and one with a much less characteristic flora. The general elevation is greater, being nowhere less than 1,000 feet (300 meters) above sea level. The limestone strata are less freely exposed, so that small valleys alternate with forested hills of acid rocky soils. The largest of these valleys is that of Flat Brook, which cuts through the hills west of the State line, branches out and runs interruptedly to Canaan and on to Queechy Lake, New Lebanon and Lebanon Springs. This valley is well shown by the map of the geological formations of the county (figure 24).

The soils of the Harlem Valley are generally fertile and mostly occupied by farms, dairying being the common farm occupation. The calcareous regions north of the Harlem Valley are less easily farmed, being somewhat more rugged in topography and including large areas of poorly drained land.

SOILS

Since the end of the glacial period and the deposition of postglacial sands and clays, the processes of decomposition and disintegration of rocks, together with the admixture of organic materials, have produced the soils of the Columbia County area. According to the Soil Survey of Columbia County (Lewis & Kinsman, 1929), the area of the county proper comprises 408,320 acres. The soils of about 25 percent of the area are derived from postglacial water-laid material; about 50 percent of the area has soils derived from glacial till; 14.2 percent is mapped as being too broken and rocky to support a definite soil type. Miscellaneous types, including recent alluvial soils, highly organic soils (muck) and tidal marshes make up the remainder. A somewhat more detailed analysis of these soil-types will be of interest.

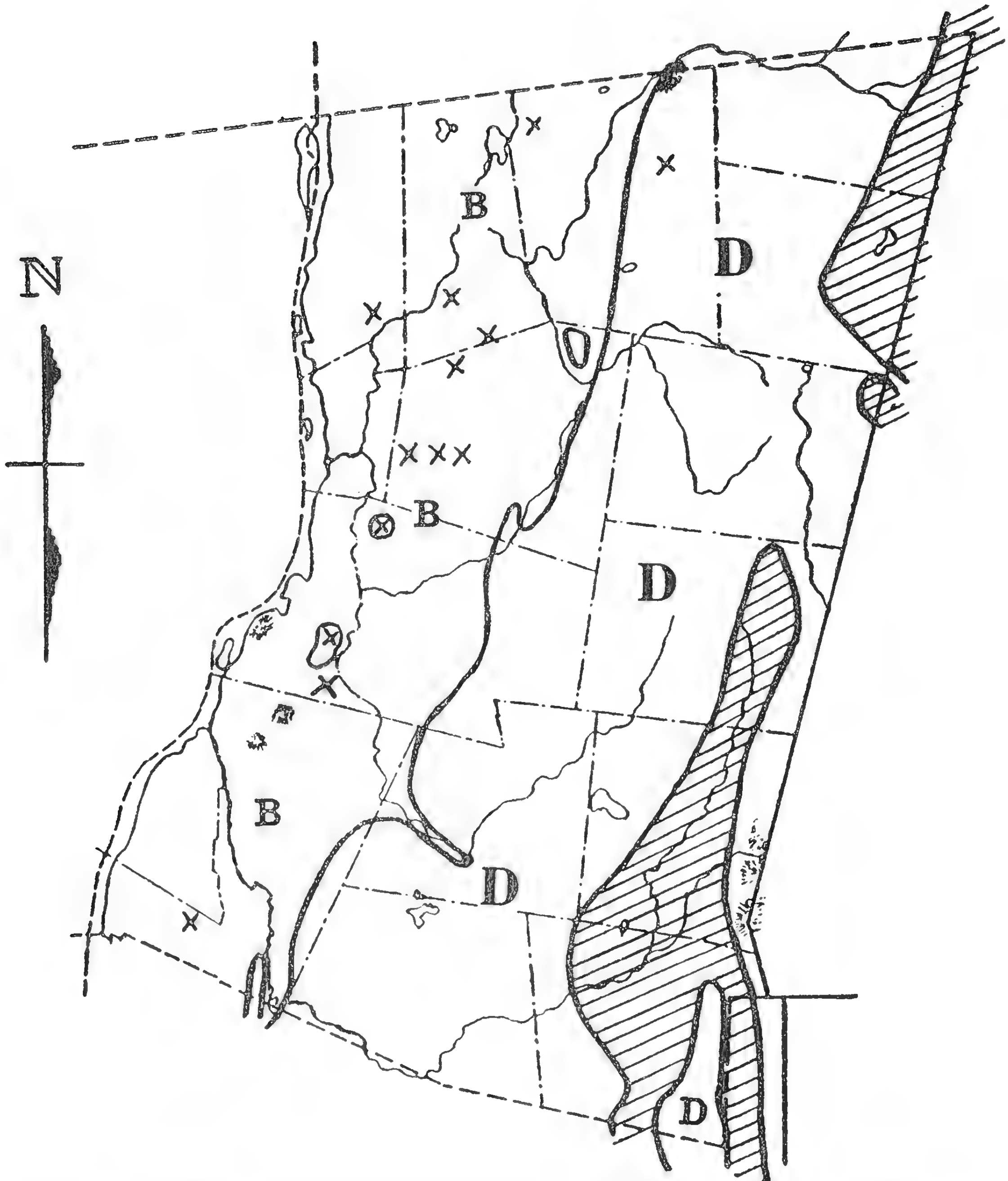

Figure 23. Sketch map of main features of distribution of soil types in Columbia County: 1) shaded areas represent regions of prevailingly calcareous soils; 2) areas marked "D" are those in which soils of the Dutchess series predominate; soils mostly acid and influenced to some extent by the underlying rocks; 3) area marked "B" is one of: a) shallow, slightly calcareous, shaly soils (Cossayuna series) and b) water-laid soils, mostly of the Hudson and Hoosic series. Outcrops of limestone are indicated by X. Small outlying soil areas of all sorts have been omitted except one in Ghent and one in Clermont belonging to the Dutchess series.

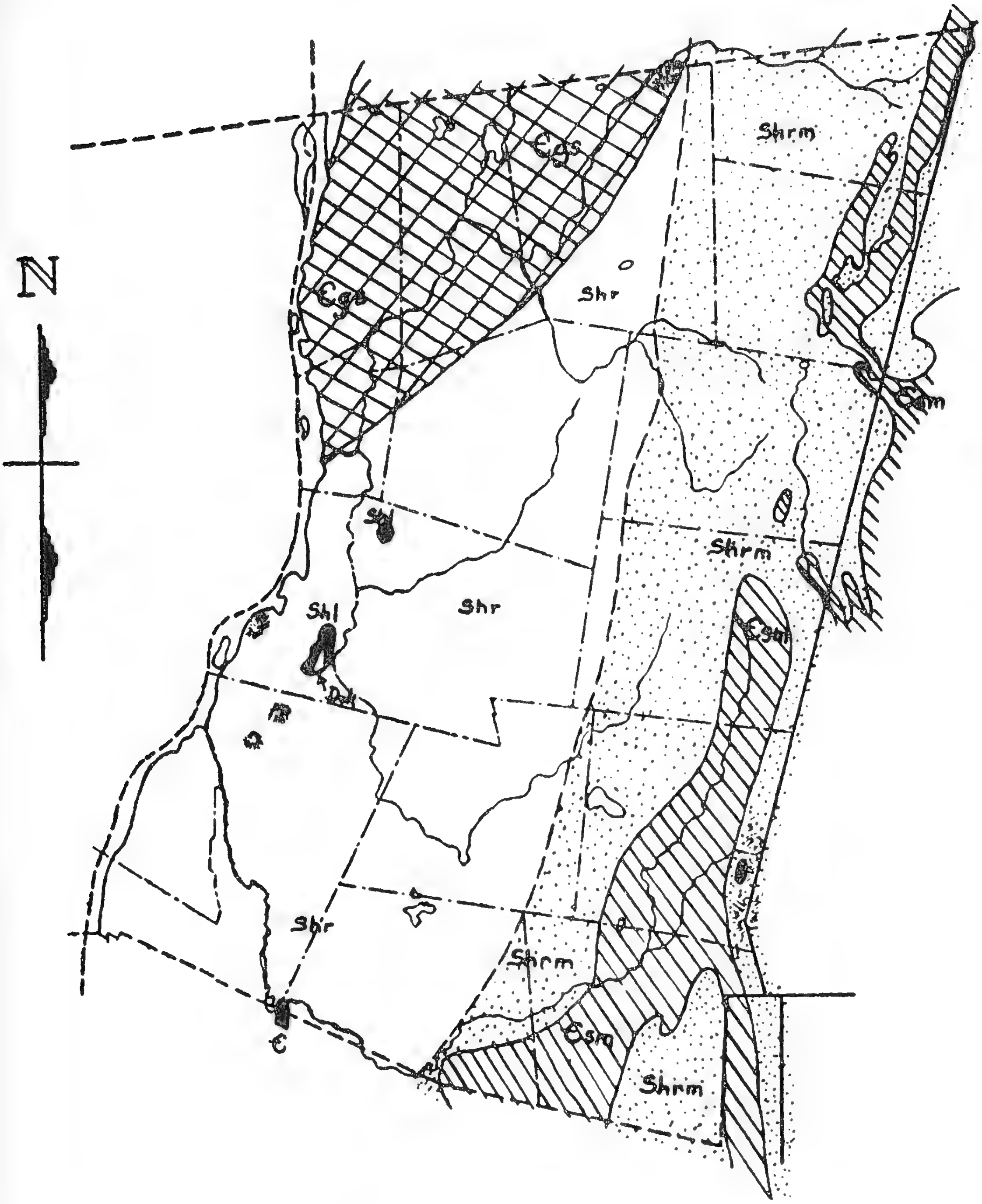

Figure 24. Sketch map of the geology of Columbia County, taken from the Hudson-Mohawk sheet of the Geologic Map of New York (1901)

Legend: Dok — Oriskany
Shl — Helderberg
Shrm— Hudson River, metamorphosed
Shr — Hudson River
Esm — Cambro-Silurian metamorphosed
E — Cambrian, undivided
Egs — Georgia

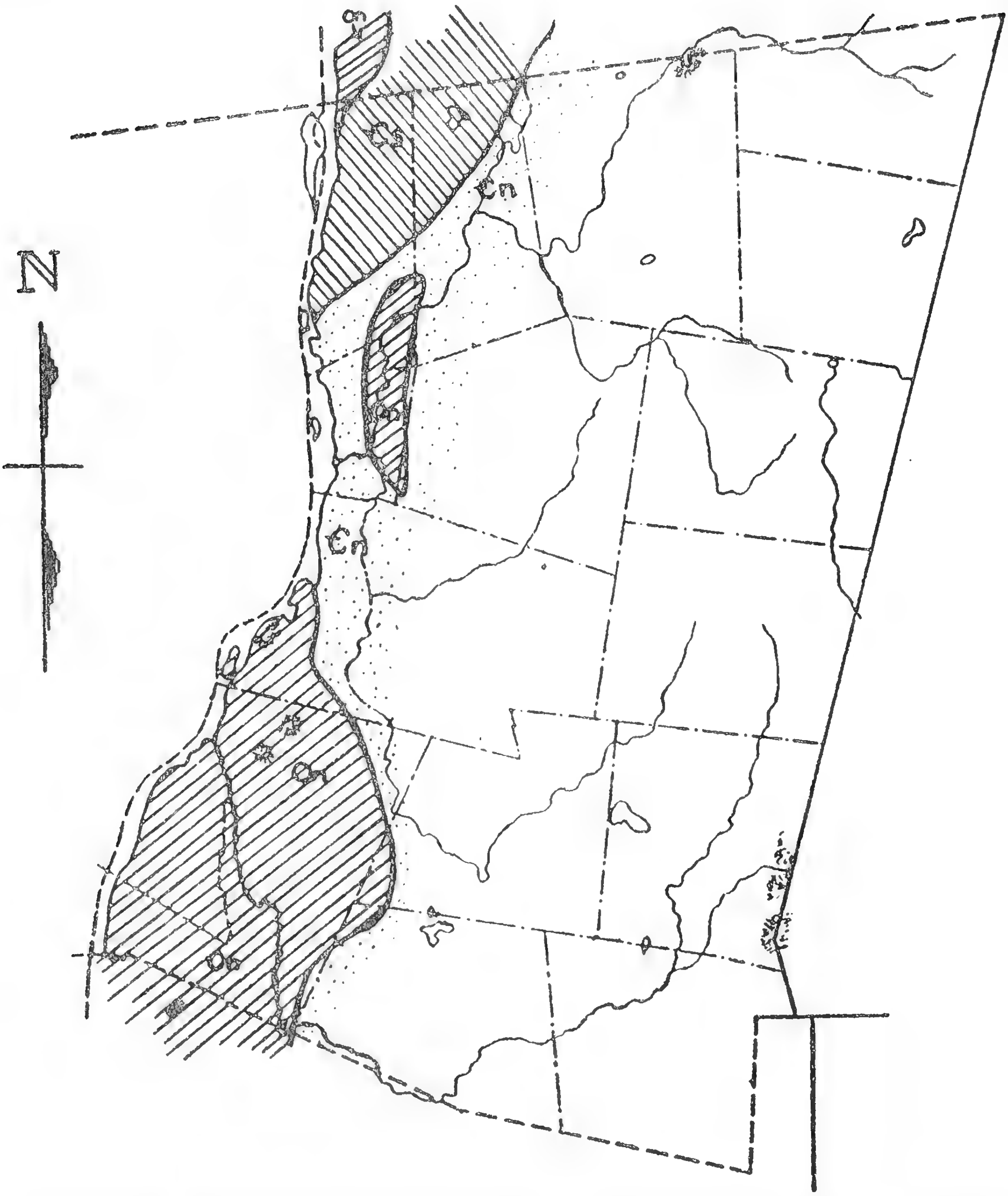

Figure 25. Sketch map of the geology of the western part of Columbia County, showing approximate extent of the principal formations. Data for this map were available through the kindness of Dr. Rudolf Ruedemann and Miss Winifred Goldring. Numerous small outcrops not shown. The eastern part of the county has not been thoroughly studied since the publication of the Geologic Map of 1901 (figure 24). Eastward the Nassau beds (En) are replaced about as shown in figure 24 by the harder metamorphic schists and quartzites.

Legend: On — Normanskill beds. South of Hudson the Normanskill grit is exposed near the river, while farther east the Normanskill chert predominates.

Es — Schodack beds

En — Nassau beds

Following the procedure of the Soil Survey (Lewis & Kinsman, 1929), the soil series are arbitrarily arranged in groups, as follows:

1. Soils derived from water-laid materials, lying above stream overflow and containing little or no lime in the parent material. Hoosic, Merrimac, Ghent, Claverack, Hinckley and Otisville series.

2. Soils derived from water-laid materials with some lime present in the parent materials. Hudson, Copake and Groton series.

Most of the acreage of the water-laid soils is to be found in the Hudson Valley, at elevations of 300 feet (90 meters) or less. As mentioned above, the sands and clays from which these soils were derived are thought to have been deposited by streams against an unmelted ice tongue in the river valley. In general, these soils are intensively cultivated, although some of the Otisville and Hinckley series and several thousand acres of the Hudson silty clay loam occupy slopes too steep for cultivation. Practically all the land has been cleared, so that native vegetation has been destroyed or greatly modified. The Hoosic and Otisville series, which together make up about 10 percent of the total area of the county, are for the most part sandy or gravelly loams, often highly acid in reaction (pH 4.5 to 5.5). The native vegetation has been largely superseded by crop plants. A soil type such as the Hoosic coarse sandy loam, for example, nearly 5,000 acres (about 2,000 hectares) of which occur in and near the village of Kinderhook, is planted almost solidly to orchards. The only important exceptions are the cemetery and a part of the village itself, both of which occupy valuable apple land. As a consequence of such wholesale clearing of the land, a student of the vegetation has to glean such things as he may from old records and from such plants as now exist nearby on steeper uncultivated slopes; the latter, however, may prove untrustworthy, as conditions prevailing at present in second-growth areas may be quite different from those formerly in existence in the original forested lands.

The Hudson soils, which make up about 8 percent of the area of the county, are for the most part silty or clay loams, rather poorly drained, rather acid at the surface, but under undisturbed conditions somewhat less so than the sandy soils of the Hoosic series (the pH of the Hudson soils is usually 5.5 to 6.5). These soils occupy most of the area within the river towns of Stuyvesant and Stockport; farther south, in Greenport, Livingston, Germantown and Clermont, they are less extensive and occur intermingled with areas of the Cossayuna series. The vegetation of the Hudson soils is now mostly a man-made one, except for the steep slopes and ravines along the river, where cultivation is impossible and native species flourish.

3. Soils derived from deep, unassorted glacial till and containing lime in the parent material. Stockbridge and Lyons series.

4. Soils derived from deep glacial till material, unassorted and containing no lime. Gloucester and Bernardston series.

5. Slightly calcareous soils derived from thin glacial till over hard rock. Pittsfield and Cossayuna series.

6. Soils derived from shallow or deep till material, influenced to some extent by the underlying bedrock and containing little or no lime. Dutchess and Mansfield series.

When the soils derived from glacial till are considered as a whole, it may be seen that four types only are extensive enough in our area to merit separate consideration. The Stockbridge series occupies much of the lower slopes of the limestone valleys in Canaan and New Lebanon where cultivation is extensive and much of the land is used for pasture. Rock outcrops are frequent and steep wooded slopes are mixed with the pastured areas.

The soils of the Pittsfield series occupy nearly 5 percent of our area, occurring both in the Hudson and Harlem Valleys. Probably 80 to 85 percent of this soil type has been cleared (Lewis & Kinsman, 1929). The surface reaction may be acid (pH 5.5 to 6.5), but the lower horizons are neutral or alkaline. These soils occur on the lower slopes of limestone hills and uplands. The underlying limestone outcrops frequently on the steeper slopes and some of the soil may be unfit for cultivation because of the proximity of the bedrock to the surface. In the Hudson Valley, soil of the Pittsfield series occurs principally in the vicinity of Becraft Mountain. The native vegetation of the Pittsfield series, like that of the soil types previously discussed, is known but poorly, and that only from study of steep slopes unfit for farming.

In the Hudson Valley most of the soil which lies more than 300 feet above sea level (90 to 100 meters) is referred to the Cossayuna series. The Cossayuna soils comprise roughly 36,000 acres, or about 8.8 percent of the county, and are gravelly loams derived from a mixture of shale, sandstone and limestone, with a surface acidity usually between pH 5.5 and 6.5. These soils are often shallow, with many rock fragments intermingled, and occur in small units interrupted by many outcrops of shale or, less often, limestone. They occupy a series of north-south ridges, with the bedrock often exposed on the sides of the ridges and the soil formed between them. This sort of topography is very characteristic of the towns of Germantown and Clermont and of a broad belt running through the central part of the town of Chatham and on southward through Ghent and Claverack. Practically all of the Cossayuna soils have been cleared, but

a great many small areas are too steep and rocky for cultivation or even for pasture. We know little regarding the original vegetation of the farmed areas, but it is probable that the many characteristic species found on the shale ledges and outcrops in the Hudson Valley have persisted there since before the advent of the white man.

The Cossayuna soils, like those of the Hoosic series, are now of some importance as apple-growing soils. Both series include well-drained soils, light textured and varying but little in the upper 4 to 6 feet (about 1 to 2 meters), and without a heavy subsoil or other substratum. Batjer and Oskamp (1935) have shown that there is a definite correlation between deep-rooted trees and those of high production. Hence the Hoosic and Cossayuna soils (where the latter are deep enough) are well suited to apple production. On the other hand the Hudson soils, with relatively heavier subsoils (sometimes as much as 90 percent of colloidal material within 30 inches of the surface), are much less productive.

The most extensive soil series in the Columbia County area is the Dutchess series, the soils of which occupy roughly 30 percent of the entire county. In the region of metamorphic rocks (that is, east of the Hudson Valley) these are the predominating soils. They are derived from till and from underlying schists. Their reaction is usually acid (scarcely ever more alkaline than pH 6.0 to 6.5) and the content of organic matter is generally low. In addition to the area mapped as "soils" by Lewis & Kinsman, 56,832 acres (13.9 percent of the county area) are mapped as "Rough Stony Land." Most of this occurs along with the soils of the Dutchess series on slopes too steep and broken to support much soil. The underlying rocks are, of course, similar to those from which the "soils" have been derived, so that about 40 percent of the entire area is seen to be characterized by this type of substratum. It is the prevailing type east of the Hudson Valley, except in the Harlem Valley and in the smaller lowland in Canaan and New Lebanon (see soil map, figure 23).

The Dutchess soils are, in general, upland soils, fairly well drained and relatively shallow. Rock fragments are frequent in the soil itself, and the bedrock frequently outcrops on the steeper slopes. So far as known there is no virgin timber remaining, but many of the steeper hillsides are covered with second growth forests. Much land that was once cultivated has reverted to pasture and is growing up to forest, or has been abandoned altogether. The vegetation is doubtless quite different from that originally present, and is mainly of dry, acid soil woodland types.

7. First bottom (alluvial) soils. Ondawa, Livingston, Hotaling and Saco series. These soils are not extensive in Columbia County, occur-

ring only along the larger streams. Considerable areas are poorly drained and are often used for pasturage.

8. Soils derived from organic matter (muck). As mapped by Lewis & Kinsman, muck occupies 3,520 acres in Columbia County, in small, widely scattered areas. The vegetation of these areas is in part undisturbed, or nearly so, although some of them are pastured.

9. Miscellaneous soils and conditions. These include :1) lands too rough and stony to support a definite soil type; 2) tidal marsh, of which 896 acres are mapped; 3) made-land, along the Hudson River. At the time of the soil survey 192 acres were mapped, but this has now been considerably increased by additional dredging along the river; 4) meadow. This last is extensive in the county, comprising roughly 15,000 acres of poorly drained strips along streams, about ponds and in similar situations. It is mostly pastured and the vegetation has been somewhat modified thereby.

The figures given in the preceding discussion for acreage occupied by the various soil types, as well as those dealing with the percentages of the total area occupied by individual soils, refer solely to the area dealt with by the Soil Survey of Columbia County, and are taken directly from that publication. The area included in the present study extends considerably beyond the political boundaries of Columbia County, especially northward, but it is impracticable to secure exact figures of acreages of soil types except for the actual county units.

The soils of the part of Rensselaer County covered by the present study are essentially like those of the eastern part of Columbia County, including the Dutchess and related series. The topography is also similar to that of the eastern part of Columbia County proper, and the floras of the two areas are essentially the same.

CLIMATE

The vegetation of any given region depends largely upon the combination of the factors of soil and climate. While some plants thrive under widely varying conditions of both soil and climate, and hence are found widely distributed over the earth's surface in all sorts of situations, the majority are greatly influenced either by the chemical and physical properties of the soils in which they grow (edaphic factors) or by the conditions of light, moisture, temperature and other climatic factors. In any study like the present one it thus becomes necessary to make an examination of the climatic factors involved as well as the edaphic ones. Unfortunately for the student of plant life, the climatic factors which are most important in determining the distribution of plants are not always the factors which are commonly studied and recorded by our weather bureaus. For

example, the weather bureau records the amount of precipitation, which is the amount of water that actually falls; the water which affects the plant, however, is not that which falls but that which stays in the soil and in the air surrounding the plant. Figures of this sort are not available except for areas which have been especially studied, but are of the greatest importance to the farmer as well as to the scientist.

The climate of the Columbia County area is in general a moderate and uniform one. The area discussed under the heading "climate" will include the whole area of the present study, while the discussion of soils was limited somewhat to the actual political boundaries of the county. The two most important climatic factors, temperature and moisture, vary but little throughout the area.

Data are now available for a number of localities east of the Hudson River, both in Columbia County itself and in the adjoining counties to the north and south. The following figures were taken in great part from "The Climate of New York State" (Mordoff, 1934), but some of them were furnished through the kindness of John C. Fisher of the United States Weather Bureau, Ithaca, N. Y.

TABLE 1

Duration of Records

Station	Number of years of record						
	MONTHLY TEMP.	MAX. TEMP.	MIN. TEMP.	FROST DATES	MONTHLY PRECIP.	SNOW	WIND
Chatham	17[1]	17	17	16	17[1]	16	17
Canaan	3				3		
Hudson	25	25	25	25	29	9	9
Kinderhook	17				17		
Lebanon Springs..	5						
Spencertown					6		

[1] Records for Chatham were made at Canaan from September 1900, to June 1904.

TABLE 2

Mean Monthly Temperature

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Canaan	19.7	20.6	36.3	44.8	55.4	61.9
Chatham	23.7	22.5	34.0	46.6	57.7	66.0
Hudson	23.0	23.5	34.9	46.9	58.2	66.3
Kinderhook	22.9	23.3	33.7	46.3	57.3	65.5
Lebanon Springs	20.3	21.3	30.3	43.4	56.1	66.1

TABLE 2

Mean Monthly Temperature

	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Canaan	68.2	67.1	60.3	50.2	36.1	22.6
Chatham	71.8	69.4	62.2	51.9	38.5	27.3
Hudson	71.6	68.7	62.6	51.8	39.6	27.8
Kinderhook	70.2	68.5	60.3	47.5	38.3	25.2
Lebanon Springs	68.1	67.0	58.9	46.5	36.7	25.5

TABLE 3

Mean Minimum Temperature

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	15.7	13.1	24.3	35.5	45.4	54.0
Hudson	16.2	14.5	25.7	36.3	46.8	55.4
	JUL.	**AUG.**	**SEP.**	**OCT.**	**NOV.**	**DEC.**
Chatham	60.2	58.0	51.3	41.6	30.5	19.9
Hudson	60.9	58.3	52.1	41.4	31.4	20.2

TABLE 4

Mean Maximum Temperature

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	32.8	31.9	43.6	57.7	69.5	77.9
Hudson	32.6	32.5	44.1	57.4	69.5	77.3
	JUL.	**AUG.**	**SEP.**	**OCT.**	**NOV.**	**DEC.**
Chatham	83.6	80.7	73.2	62.1	46.4	34.8
Hudson	82.3	79.4	72.8	61.9	47.7	35.2

TABLE 5

Lowest Temperature

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	—18	—24	—9	16	24	34
Hudson	—21	—18	—6	9	28	37
	JUL.	**AUG.**	**SEP.**	**OCT.**	**NOV.**	**DEC.**
Chatham	42	38	20	20	8	—20
Hudson	42	36	30	19	6	—19

TABLE 6

Highest Temperature

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	65	57	81	90	96	99
Hudson	62	60	82	90	94	100
	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Chatham	103	100	95	86	71	64
Hudson	102	103	95	86	74	67

TABLE 7

Frost Dates

	LAST FROST IN SPRING			FIRST FROST IN FALL		
	EARLIEST	AVERAGE	LATEST	EARLIEST	AVERAGE	LATEST
Chatham	Apr. 16	May 11	May 27	Sep. 11	Oct. 4	Oct. 26
Hudson	Apr. 11	Apr. 29	May 12	Sep. 15	Oct. 9	Oct. 27

TABLE 8

Length of Growing Season (days)

	LONGEST	AVERAGE	SHORTEST
Chatham	177	146	118
Hudson	187	163	126

TABLE 9

Percent of Recorded Growing Seasons Less Than

	120 DAYS	130 DAYS	140 DAYS	150 DAYS
Chatham	13	13	44	50
Hudson	0	4	8	12

TABLE 10

Mean Monthly Precipitation (inches)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	2.24	2.51	3.06	3.70	3.04	3.99
Hudson	2.70	2.66	2.66	3.09	3.17	3.90
Kinderhook	2.21	1.53	2.48	2.97	3.41	4.49
Spencertown	2.59	1.57	1.56	4.62	3.90	4.05

TABLE 10

Mean Monthly Precipitation (inches)

	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Chatham	3.77	3.93	3.49	3.36	2.28	2.74
Hudson	3.87	3.65	3.14	3.89	2.95	3.18
Kinderhook	4.36	3.23	2.84	3.26	2.69	2.76
Spencertown	3.84	3.74	3.00	2.61	2.66	2.83

TABLE 11

Precipitation: Average Number of Days Having 0.01 Inch or More

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	9	8	10	11	12	11
Hudson	6	5	5	7	8	10
	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Chatham	10	11	11	9	9	9
Hudson	8	9	6	5	6	6

TABLE 12

Annual Precipitation (inches)

	MEAN	HEAVIEST	LIGHTEST
Chatham	38.11	51.04	26.50
Hudson	38.86	48.71	25.72
Kinderhook	36.23	51.46	25.95

TABLE 13

Growing-Season Precipitation (inches)

May 1 to September 30

	MEAN	HEAVIEST	LIGHTEST
Chatham	18.22	29.28	12.17
Hudson	17.73	27.88	10.24
Kinderhook	18.33	26.03	13.04

TABLE 14

Mean Monthly Snowfall (inches)

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Chatham	10.5	15.0	12.1	2.8	T	0
Hudson	17.3	16.2	6.8	2.5	0	0

TABLE 14

Mean Monthly Snowfall (inches)

	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
Chatham	0	0	0	T	3.5	10.2
Hudson	0	0	T	0.2	1.9	8.9

Analysis of the above figures brings out a number of interesting points. It has been pointed out repeatedly that means of temperature and precipitation records have less significance for plants than do extremes. In growing a perennial crop, like peaches, it is important to know not only how cold the winter usually gets, but how cold it *may* get; a single week of extreme cold may kill a peach orchard which has survived 30 ordinary winters. The same thing is true of native vegetation, with the important difference that the native plants have no way of reestablishing themselves quickly. As a consequence, the native species making up the vegetation in any given region are those which, having entered the region, have survived the most severe winters. The same reasoning applies to conditions of moisture, although native plants are much less affected by a very dry season than are the less well-adapted cultivated ones. It must be remembered also that climatic records have been kept for a relatively short time. A continuous climatic record of 100 years is a long one as climatic records go, but plants have been living in the Hudson Valley for perhaps 10,000 years. The present flora of the Columbia County area is made up, at least in part, of species which have been able to survive the coldest and driest times of that long period. At the present time an equilibrium has been established, and where winters chance to be a little more severe than usual, or the droughts slightly more severe, we find the native species relatively little affected by these extremes.

a. Mean and extreme temperatures. Examination of tables 2 to 4 shows that mean monthly temperatures run consistently lower at the two upland weather stations, Lebanon Springs and Canaan (elevations roughly 250 to 275 meters above sea level) than at the three Hudson Valley stations of Hudson, Kinderhook and Chatham (elevations from sea level to about 150 meters). It will be noted also that the mean minimum temperatures run consistently lower at Chatham than at Hudson, while the mean maxima are about the same for the two stations.

b. Frosts and length of growing season. In tables 7 to 9 the data indicate that Hudson, at sea level on the river, has a growing season which averages 17 days longer than that at Chatham, which is near

the eastern edge of the Hudson Valley at an elevation of about 150 meters. It is probable that this is a significant difference from the standpoint of vegetation. While figures for the eastern parts of our area are not available, the indications are that the growing season is notably shorter at the higher elevations. The vegetation is considerably later in its development in the spring at the higher elevations. In May 1936, at several localities in the towns of Austerlitz and Canaan, at elevations of 300 to 600 meters, Dutchmans' Breeches (*Dicentra Cucullaria*), Hepatica (*H. americana*), Rue Anemone (*Anemonella thalictroides*) and Pepperroot (*Dentaria diphylla*) were in full flower (May 1 to 5). In the vicinity of Kinderhook, in the Hudson Valley, the same species had been at the same stage of development at least 10 days earlier. It is probable also that lower temperatures prevail in winter at the higher elevations. While unofficial temperatures in the Hudson Valley range as low as —30° F., the lowest officially recorded at either Chatham or Hudson is −24° F.; at Austerlitz and Spencertown unofficial temperatures ranging from —40° to —48° F. are recorded.

c. Precipitation. Tables 10 to 14. The average annual precipitation over all our area ranges from 35 to 40 inches (roughly 90 to 100 centimeters). The minimum is about 25 inches and the maximum about 50 inches. These figures are comparable to those for most of the forested lands of northeastern United States. The rainfall is rather evenly distributed throughout the year, with the lowest monthly precipitation from November to February and the highest from April to August. The summer months are not those of least rainfall, as they are popularly regarded, but the high temperatures prevalent in July and August increase surface evaporation and the visible effects of a light summer shower soon disappear, leaving the ground apparently dry.

Another point which may be considered is that while precipitation may be ample in total amount it may be poorly distributed as far as plants are concerned. Table 11 shows that the average number of days with 0.01 inch or more of precipitation (that is, days when it rains more than a few drops) is only 7 to 12 per month during the summer months. The remaining two or three weeks of the month are without rain. The Hudson Valley has from 20 to 30 thunderstorms every year; these storms are more frequent there and on Long Island than in any other part of New York (Mordoff, 1934). Much of the summer rain thus falls in a relatively few storms, so that a given month may have rain on but two days, for example, and still have a total of 4 or 5 inches of precipitation. A climate of this kind, where rain falls mostly in ample but infrequent showers,

is well suited to the growth of forests. The same amount of precipitation evenly distributed in many small showers would be better suited to the growth of shallow-rooted plants like grasses.

SETTLEMENT

The first white settlements in the Columbia County area were doubtless in the lowlands along the Hudson River. Henry Hudson ascended the river which now bears his name in 1609, reaching a latitude of 42° 18′ (Collier, 1914, p. 2). The name Kinderhook appears on Adriaen Block's (possibly Cornelius Hendrick's) "Carte Figurative" dated 1614-16, and so is thought to be earlier than any other present-day place name in the State (Collier, 1914).

Settlers, most of them Dutch, soon followed Hudson's trail. The Indians of this part of the country were Mohicans, a tribe of the Lenni-Lenape, and were usually on friendly terms with the settlers. According to Collier they were apparently "numerous and strong at the time of Hudson's visit and for twenty years thereafter." Under the regime of the Dutch and, after 1664, that of the English their lands were generally bought from them so that they remained friendly. They refused, indeed, to sell land, even at the site of Fort Orange (Albany) until after 1625, but were disastrously weakened by battles with their Mohawk enemies soon after this and white settlers began to come here in greater numbers. Under the white man's rule the number of Indians dwindled rapidly, and in 1689 there were but 250 left in the entire county of Albany (at that time including most of Columbia County). Seven years later the number of Indians was reduced to 90 (Collier, 1914).

The first white settlements in what is now Columbia County seem to have been about 1640, and as early as 1651 Kinderhook was alluded to as one of the principal settlements on the river. The oldest house in the county, the Staats house near the Stockport station of the New York Central Railroad, is thought to date approximately from this time.

The Colonial Assembly of 1683 established Albany County, which then included Albany, "Schonectade" and all the land east of the Hudson River as far south as "Roeliffe Jansen's creeke." Roeliff Jansen, according to French (1860) was "Overseer of the Orphan Chamber," an office similar to that of Surrogate under the Dutch government.

The Livingston manor was patented in 1686 and comprised over 160,000 acres, including most of what is now the southern half of Columbia County. Settlement was slow, and in 1701 there are said

to have been but four or five houses on it. In 1710 a group of Germans from the Palatinate settled along the river at the present site of Germantown, and the following year there were 1,178 settlers in the town, a population not far from that of the town of Germantown today.

The country back from the river was somewhat less accessible and was settled slightly later than that adjoining the waterway. Chatham dates from about the year 1725, and Ghent from a few years later (about 1735), while Greenport was settled about 1750. About the middle of the 18th century the eastern part of our area was also occupied by emigrants from Massachusetts and Connecticut. Canaan, Copake, Hillsdale and Ancram were established as early as the decade 1750-60, while Austerlitz dates from between 1745 and 1750. The present town of New Lebanon was occupied as early as 1760 by people from New England, and more of these same travelers reached Canaan and Chatham about the same time. The above historical sketch, together with a part of what follows, is taken from French (1860).

After 1750 settlement and civilization advanced apace. The Copake Iron Works began operations in 1756 and later became nationally famous, several furnaces having been established in Copake and Ancram. An article in the American Journal of Science (6: 180. 1823) reads as follows:

> Mr. Walter Patterson, in charge of the Ancram iron furnace, said that it was the first erected in the colonies of North America, or at least in New York. The presence of zinc is said not to affect the properties of iron, since the bar-iron of Ancram is in great demand at $120 a ton, a higher price than that paid for any imported iron. No other pigs are used at the West Point foundry for the heavy guns (32 and 42 pounders) now casting for the United States' navy.

The iron works at Copake was not abandoned until the closing years of the 19th century. Another thriving industry arose through the utilization of the large deposits of carbonate ore in the Hudson Valley just south of Hudson. These, the so-called Burden mines, had a large output and a spur railroad, now abandoned, to the New York Central. The output of carbonate ore in 1888, according to Smock (1889), was 112,000 tons. The limonite ores of the Hudson Valley in that year produced only 43,000 tons in Dutchess and Columbia Counties combined.

Another early industry was that of the Ancram lead mine, which gave its name to a village. The same village, now known as Ancramdale, appears on maps of 1845-50 as "Hot Ground," and is thus

designated by Hoysradt (1875-79). The lead mine, according to an early note in the American Journal of Science (Lee, 1824) was worked for four or five years and then abandoned. At present all that is visible is a rocky hole, partially filled, in a hillside near Ancramdale.

By 1787 New Lebanon came to be considered the central home of the Shakers, the followers of "Mother Ann" Lee, and in 1823 there are estimated to have been about 600 of the believers living in the village (Andrews, 1933).

Columbia County was formed from Albany County in 1786; the first newspaper had been established in the new city of Hudson the previous year; a paper mill appeared in Stuyvesant Falls in 1802 and a cotton "factory" in 1813 at the same place (French, 1860). The towns of Canaan, Claverack, Germantown, Hillsdale, Kinderhook and Livingston were established under the new regime in 1788, while Clermont was a year older. The town of Chatham was made up from parts of Canaan and Kinderhook in 1795, and in 1803 "Gallatin" and "Granger" were separated from Livingston. These changed their names in 1814 to Ancram and Taghkanic, respectively. In 1818 the town of Austerlitz was blocked out on the eastern side of the county. New Lebanon was made a town apart from Canaan, and Ghent was established from parts of Chatham, Claverack and Kinderhook. Stuyvesant, which had been a part of Kinderhook since early days, was separated from it in 1823, and the next year Copake was made a town from a part of Taghkanic. A new town of Gallatin was separated from Ancram in 1830, Stockport was established in 1833 and Greenport was set up, independent of Hudson city, in 1837.

The whole of Columbia County was thus loosely organized politically as early as 1788; it apparently reached nearly its present status about 1820, and took final political shape about a century ago. The one exception was the thousand-acre tract called the "Boston Corners," which was adjacent to the town of Ancram but belonged to the town of Mount Washington, Mass. It was separated from the rest of Mount Washington, including the majesty of the law, by the 1500-foot wall of the mountains which rise there sheer above the valley. Thus favored by nature, it became a favorite haunt of gamblers and other lawbreakers and fugitives from Massachusetts justice! It was finally ceded to Ancram in 1857 (French, 1860).

Although such early organization existed, the condition of the country was by no means the same then as now. A map of Kinderhook drawn in 1798 (Collier, 1914, facing page 124) shows fewer than 100 houses in all the territory now occupied by the combined

towns of Kinderhook and Stuyvesant, which have a present total population of 4,544 (census of 1930). In 1802 were published some "Notes on the Natural History of Kinderhook" (Warden, 1802) which bear out the same contention. Much of Reverend Warden's material has nothing to do with our subject, but in the midst of other matters he mentions the dry summer of 1799 when all the inhabitants of the village were obliged to be very careful of their fires in order to avoid setting the woods afire. The implication is that the woods were considerably more extensive than at present.

Warden also mentions riding horseback just north of Kinderhook Lake; any land dry enough for horseback travel there is now closely grazed pasture, but in his day he tells of forcing his horse with difficulty between the gigantic trunks of oak and pine growing closely together.

Some additional evidence exists which seems to show that clearing of the woods was rather a slow process. It has been pointed out (McVaugh, 1935) that a number of species of plants recorded from the Hudson Valley in 1838 and 1839 are now rare in the same area or entirely wanting. These are for the most part plants characteristic of the cool woods of northern latitudes; they apparently existed in the original forests of the Hudson Valley but have mostly disappeared along with the forests themselves. There remain to this day scattered localities, some of them within a few hundred yards of the Hudson River, where are found in abundance such upland or boreal species as *Taxus canadensis, Coptis groenlandica, Acer spicatum* and *Viola rotundifolia.* These localities are, without exception, those that seem to have been undisturbed by fire, grazing or agriculture. Essentially the same conclusions have been drawn from a study of the virgin forest in northwestern Connecticut (Nichols, 1913): "Striking is the relative abundance of northern species which elsewhere in the state are either absent or confined to cool ravines."

Habitats suitable for species like the above are scarce in the Hudson Valley today. A century ago they were somewhat more frequent and the probability is that at least a part of the original forests still persisted. The Hudson Valley is stressed in the above paragraphs for two reasons. The first reason is the very practical one that most of the available records come from that part of the area. The second is that this was the first part of the area to be settled, and so was doubtless cleared of its forests first. If parts of the original vegetation persisted there, they surely did so elsewhere.

While much of the timber was probably still standing in 1800, the older census records show that by 1835, at least, the areas of "improved land" in the county were as extensive, if not more so,

than the nonforested lands at the present time (table 15). The number of acres of improved land in 1835 was 307,354 (Gordon, 1836). The number of acres of land in farms in the county in 1920 was 339,560 (Lewis & Kinsman, 1929). While in 1835 at least a part of the "unimproved" land was covered by virgin forest, all of the land now listed as nonfarm land is covered with second growth woodland or with weeds and bushes.

In 1821, according to Spafford (1824), there were 67 sawmills in the county. In 1835 the number had dwindled to 46 (Gordon, 1836). These figures would seem to indicate that while large amounts of timber were still being cut in 1835 (annual value of $40,305, according to Gordon), the peak of production had been passed a few years before.

TABLE 15

ACREAGE OF IMPROVED LAND IN COLUMBIA COUNTY

TOWN	DATE 1821	1835	1858
Ancram [1]	26,217	21,519	21,135
Austerlitz	18,780	21,163	22,805
Canaan	13,837	15,476	16,501
Chatham	19,671	25,225	26,856
Claverack	18,560	22,695	25,055
Clermont	11,850	12,726	10,231
Copake [2]	......	17,913	18,344
Gallatin [1]	......	14,116	17,588
Germantown	3,626	5,477	5,768
Ghent [5]	17,342	20,470	22,506
Greenport [3]	......	......	9,866
Hillsdale	23,912	23,386	21,058
Hudson [3,5]	8,695	12,226	373
Kinderhook [4]	21,965	18,258	15,865
Livingston	18,587	21,539	20,648
New Lebanon	15,525	18,778	16,218
Stockport [5]	......	7,146	5,650
Stuyvesant [4,5]	......	13,361	10,820
Taghkanic [2]	26,233	15,908	16,991

[1] Gallatin included in Ancram until 1830.
[2] Copake included in Taghkanic until 1824.
[3] Greenport included in Hudson City until 1837.
[4] Stuyvesant included in Kinderhook until 1823.
[5] Stockport formed from parts of Hudson, Ghent and Stuyvesant in 1833.

In the period from 1821 to 1835 the area of improved land increased by 62,554 acres, while in the 23 year period from 1835 to 1858 the area decreased by 3,077 acres. Tabulated by towns, the figures are as follows:

TABLE 16

CHANGE IN NUMBER OF ACRES OF IMPROVED LAND, 1821 TO 1858

TOWN	INCREASE IN ACRES, 1821 TO 1835	INCREASE IN ACRES, 1835 TO 1858
Ancram-Gallatin	9,418	3,088
Austerlitz	2,383	1,642
Canaan	1,639	1,025
Chatham	5,554	1,631
Claverack	4,135	2,360
Clermont	876	—2,495
Copake-Taghkanic	7,588	1,514
Germantown	1,851	291
Ghent-Greenport	....	....
Hudson-Stockport	....	....
Kinderhook-Stuyvesant	23,495	—6,381
Hillsdale	—526	—2,328
Livingston	2,952	—891
New Lebanon	3,253	—2,560

Analysis of table 16 shows that the towns lying wholly or mostly in the Hudson Valley (Stuyvesant, Kinderhook, Ghent, Stockport, Hudson, Greenport, Livingston, Germantown and Clermont) showed a total increase of 29,138 acres of improved land during the period 1821 to 1835. This amounts to an increase of 35.5 percent over the area improved in 1821. During the period from 1835 to 1858, however, the improved acreage in the same towns decreased by a total of 9,476 acres, or 8.5 percent of its area in 1835.

When the figures for the remaining towns of the county are tabulated, the increase in improved acreage for the period 1821 to 1835 is seen to be 33,444 acres or 20.5 percent of the area in 1821. During the period 1835 to 1858 the increase continued, adding a total of 8,372 acres or 4.2 percent of the area in 1835.

The above figures are taken to indicate that the Hudson Valley was cleared somewhat earlier than the eastern portion of the county as the towns along the river were more easily accessible, were settled earlier and were possessed of more easily disposable timber. Apparently the peak of expansion was reached, as far as agricultural use of land is concerned, about 1835 or soon thereafter. By 1858 expansion had stopped and the less fertile areas or those difficult to cultivate were being allowed to revert to woodland. In the less accessible parts of the county, where conditions were less favorable for agriculture, expansion was slower but continued until much later.

The conclusions drawn from the preceding evidence may be summed up as follows: Extensive clearing of the forests was not carried on until about 1800, although there were settlers in all parts

of Columbia County by 1760. In the Hudson Valley the peak of the clearing operations may have been in the period from 1815 to 1830, while in the eastern part of the county it was somewhat later.

Although virgin forests are said to have existed in scattered patches here and there, even in the Hudson Valley, as late as 1900, examination of the rotting stumps does not bear out this contention. Few if any of the trees which stood in such localities exceeded 200 years in age or 36 inches in diameter. Such size and age are not by any means indicative of a virgin forest of white pine or hemlock, and it may well be that such remnants of the "original" forests are in actuality among the earliest of the second growth woodlands of New York; in 1700 Kinderhook and Claverack were both thriving communities, and a forest cut over at that time by the settlers of the vicinity may well have given rise, in two centuries' time, to another forest of the same general nature.

A remnant of such a mature second growth forest still stands on what are now the grounds of the Leake and Watts School at Tivoli, Dutchess County, and figures are available for a small number of trees. The trees are now widely scattered over several acres of ground, but their uniformly straight trunks and the general scarcity of branches indicate that most of their growth was made in a forest. The site occupied is the steep hillside immediately above the Hudson River. Most of the trees are white pines, ranging in age from 100 to 150 years. The following table indicates the maximum size and age attained by the several species present:

TABLE 17

Maximum size and age of species in mature second growth forest at Tivoli, Dutchess County

SPECIES	MAXIMUM SIZE	ESTIMATED AGE
Tsuga canadensis (Hemlock)	38	220
Pinus Strobus (White pine)	31	200
Quercus alba (White oak)	31	150
Fraxinus americana (White ash)	21	130

(The size is inches in diameter, breast high; the age is estimated by use of the increment borer.)

PREVIOUS BOTANICAL INVESTIGATIONS

A complete botanical survey of this region has never before been attempted. The published material dealing with the vegetation of the area consists of a number of short papers and local floras, all relatively narrow in scope. Many of them are mere lists of plants and nearly all are out of date. In addition to the papers dealing with the

immediate fields of the present study, there are a few important papers concerned with regions adjoining the Columbia County area.

The valley of the Hudson River, offering as it did a means of travel in early days when most of the country was thickly wooded and thinly settled, was rather well known to the early botanists, although few of them were well acquainted with what is now Columbia County. Pehr Kalm, the Swedish disciple of the great Linnaeus, passed through Albany in 1749; mention of his writings will be found further on in this study (p. 278) (Benson, 1937). André Michaux sailed up the Hudson to Albany in the course of his trip to Canada in 1792; on the return trip, as related in his journal, he botanized near Poughkeepsie late in November (Michaux, 1889). Pursh, the German gardener who wrote a famous flora of North America, passed down the river in 1807 after a summer spent in botanizing in central New York and in Vermont. Some of the plants from Pursh's 1807 trip still exist, but few if any of them are from the Hudson Valley (McVaugh, 1936b).

None of the above men, so far as is known, stopped in our area or collected plants therein. Somewhat later, however, the eccentric genius of the early 19th century, Constantine Samuel Rafinesque-Schmaltz, spent some time in Columbia County. He passed part of the winter of 1815-16 at Clermont, acting as a teacher of Italian, drawing and botany to the three daughters of the influential Livingston family (Rafinesque, 1836, pp. 49-50). Later, in the autumn of 1827, Rafinesque stopped at Lebanon to see the famous spring and to meet Garrett Lawrence, the botanist-gardener of the Shakers who was himself much interested in the native plants (Rafinesque, 1836, p. 85).

The first resident botanist of this part of the Hudson Valley was Amos Eaton, who was born at Chatham in 1776. He lived at Catskill, Greene County, for a number of years and later became famous as a botanist and educator. He taught at Williams College and at Rensselaer Polytechnic Institute, which he was instrumental in founding. Eaton's "Manual of Botany" was first published in 1817 at the request of his enthusiastic classes at Williams; it was issued the following year in a revised and much enlarged edition as "A Manual of Botany for the Northern and Middle States." This was the manual which doubtless was used by all the early local botanists in our region, and which was supplanted only by the more comprehensive works of Torrey and Gray. Numerous species are cited by Eaton as occurring in Columbia County, including several estuarine species with which he probably became familiar while living at Catksill. For further discussion of Eaton's life and work see Smallwood (1937).

The first known publication dealing directly with a part of the area of the present study was Stebbins' "Catalogue of Plants Growing in the Vicinity of the City of Hudson" (1830). This was a list of some 40 species and has been fully discussed in an earlier paper (McVaugh, 1936a). The names published in Stebbins' list were said to be those of the "most interesting" species, and examination of the list seems to show that a considerable proportion of them were species characteristic of the lowlands of the Hudson Valley, many of them approaching here the northern or northeastern limits of their ranges.

Stebbins' paper had been preceded in point of time by John Pierce Brace's flora of Litchfield, Conn. (Brace, 1822). Some of the species mentioned in Brace's list provide interesting comparisons with those of the Columbia County flora, although his area is not included in that of the present study. An interesting analysis of Brace's work has been made by C. A. Weatherby (1914).

In 1836 there appeared a comprehensive catalog of the plants native to the vicinity of Troy, by John Wright and James Hall. Some of the records from this 42-page pamphlet were used by Gordinier and Howe in their "Flora of Rensselaer County," published in 1894. Soon after the publication of Wright and Hall's list there were printed two similar but less comprehensive ones for the plants native about Kinderhook (Woodworth, 1839, 1840). These two lists together included about 250 species, which were "analyzed by the Botanic Class" of the Ladies' Department of the Kinderhook Academy, of which Woodworth was the principal.

The 2-volume "Flora of the State of New York" by John Torrey, published in 1843, makes numerous general references to the vegetation of the Hudson Valley. A few years later Alexander Winchell, the geologist, brought out a list of plants native to Amenia, in the eastern part of Dutchess County (1851). A Reformed Church clergyman, Rev. A. P. Van Gieson, made a collection of about 120 herbarium specimens in the vicinity of Claverack between 1869 and 1871 but apparently did not publish any notes relative to these, although certain species which he collected are exceedingly rare in Columbia County.

About this time began the careful and critical work of Lyman Hoysradt (1848-1933), who made the greatest single contribution to the knowledge of the plants of our area during the 19th century. Hoysradt was a school teacher whose avocation was botany. His home was in Pine Plains, and the results of his botanical explorations in the vicinity of that place were published while he was still a young man. The "Flora of Pine Plains" appeared in eight parts

as a series of supplements to the Bulletin of the Torrey Botanical Club over the period 1875 to 1879. The area embraced was that of a circle having a radius of 5 miles, with the center at the village of Pine Plains. All the vascular plants are included except ferns. Although Hoysradt was much interested in ferns and mentioned them several times incidentally in describing the habitats of other species, the part of the flora dealing directly with them was never published.

In the flora itself the name of each plant is followed by some statement as to habitat and abundance in the Pine Plains area, often with accompanying notes on specific localities and facts of special interest. Although the study of plant associations was not so popular then as now, Hoysradt often included some words concerning the species accompanying the particular one in question. The exact localities which he cites show that he did not confine himself strictly to his stated area; plants are included from as far east as Bashbish Falls and the summits of the Taconic Range, and from as far north as Lake Charlotte (now Taghkanic Lake).

It is evident throughout Hoysradt's work that he was a very enthusiastic and careful field worker. I have recently visited a number of the localities mentioned in the "Flora," many of them stations for rare and local plants, only to find conditions much like those described 60 years before. Hoysradt did not trust to his own identifications of the more difficult groups of plants but corresponded with many of the notable botanical figures of his time and secured their opinions. He sent a number of specimens to Asa Gray at Cambridge, and some of these are still preserved at the Gray Herbarium. Gray was particularly interested in Hoysradt's discovery of *Valeriana sitchensis*, subsp. *uliginosa* in the Harlem Valley (Gray, 1875; Hoysradt, 1875). The determinations of several groups of Hoysradt's plants were checked by experts in these fields; among these were the *Gramineae,* by Dr. George Thurber, *Carex,* by William Boott, *Juncus* by Dr. George Engelmann, and *Potamogeton,* by Dr. J. W. Robbins.

Although many of Hoysradt's stations have not been relocated and some have doubtless been destroyed, it appears that the great majority of the records are trustworthy ones, so that some species have been included in the present catalog solely upon his authority. Several others are known from the Columbia County area only through Hoysradt's specimens that are still in existence. About 250 specimens from the Hoysradt herbarium have been located in various botanical institutions. The more important sources of these are as follows:

New York Botanical Garden	78
Cornell University	86
University of Michigan	43
University of Pennsylvania	30

In addition, there are a number of sheets of *Juncus* in the herbarium of the Missouri Botanical Garden, and miscellaneous collections at the U. S. National Herbarium, the Gray Herbarium, Pomona College and doubtless elsewhere.

I had the pleasure of talking with Mr. Hoysradt a few months before his death in 1933. He had retained his youthful interest in botany although he said that he had not done any field work for 40 years. He remembered vividly his association with Asa Gray and other great personages of the past century. It is with sincere appreciation of such a botanist of an older generation that the present study is undertaken. It is only after the careful and critical work of local students like Lyman Hoysradt that more comprehensive studies over longer periods of time can be successfully carried out.

In the closing years of the 19th century and the first part of the 20th, several articles appeared which dealt with the flora of the eastern part of Columbia County. The earliest of these (Harrison, 1887) was a list of woody plants about Lebanon Springs, comprising 64 species. Among the plants included was the mountain magnolia (*Magnolia acuminata*), which had been reported from the same locality by Torrey in 1843 and was subsequently rediscovered (McVaugh, 1936c).

A few papers dealing with the flora of Copake Falls and the nearby gorge of Bashbish Brook appeared soon after 1900. These included a note on mosses (Britton, 1901) and several lists of vascular plants observed and collected in the vicinity (Stetson, 1913, 1914; Burnham, 1913; Knowlton, 1919). The flora of the Hudson Estuary was dealt with by Dr. H. K. Svenson in two short papers (1925, 1935), and the aquatic vegetation of the Hudson River and some of the larger lakes in our area have been studied in detail by Dr. W. C. Muenscher (1935, 1937).

Finally there must be some mention of several general works having some bearing upon the flora of the Columbia County area. "The Flora of the Vicinity of New York" (Taylor, 1915) included the Hudson Valley as far north as Columbia and Greene Counties and contains numerous records from the former, many of which cannot now be verified. The "Flora of Berkshire County, Massachusetts" (Hoffmann, 1922) covers that part of our region lying in the towns of Hancock and Mount Washington. Dr. H. D. House's "Annotated List of the Ferns and Flowering Plants of New York State" was

published in 1924 and gave the most complete information then available about the vegetation of the State, including many specific references to localities in Columbia County.

Since 1930 there has been a considerable amount of field work in Columbia County in botanical and allied subjects. The New York State Biological Survey finished its work on the Hudson River watershed in 1936. This included chemical and biological studies of aquatic life, of which the most pertinent to the present paper are those of Doctor Muenscher referred to above. In the field of geology Dr. Rudolph Ruedemann and Miss Winifred Goldring of the New York State Museum have been working intensively on the Catskill and Coxsackie Quadrangles, respectively. Dr. H. D. House, the State Botanist, has been much interested in the flora of the area and has made many trips to various parts of it. His collections, amounting to many hundreds of specimens, have been studied in the preparation of the present paper.

My own botanical field work in the area comprises about 350 days, distributed as follows:

A few days each in 1930, 1931 and 1932
The entire summer of 1933, from April 1 to October 1
Much of the time between July 1 and September 15, 1934
The summer of 1935, from June 23 to October 8
The spring of 1936, from April 18 to May 19
Most of the month of September 1936

THE VEGETATION

The vegetation of the Columbia County area, like that of any other area on the earth's surface, consists of a number of species of plants, each represented by one or more individuals and each influenced in its life not only by its innate (hereditary) capacities but by conditions around it. The vegetation which is to be discussed below is more or less uniform in composition throughout, but its aspect changes slightly as one goes from place to place. All of this part of New York is thought to have been covered, at one time, by dense forests; this means, naturally, wherever forest trees could grow. It is obvious that no trees ever grew on the sheer faces of cliffs; these cliffs support a wholly different sort of vegetation and always have. It is equally apparent that forests cannot grow and never could grow in the tidal marshes which are inundated twice daily; these marshes support a luxuriant flora of another kind.

Before proceeding to a more detailed consideration of the vegetation, it is well to have clearly in mind the environmental factors

which influence every plant. These may be summed up as follows (modified from Nichols, 1923):

1. Climatic factors. All factors which are associated with atmospheric conditions. The principal conditions of this kind are *a*) moisture, *b*) temperature and *c*) light. Climate may be thought of in terms of widespread atmospheric conditions; for example we may speak of the climate of North America. It should also be remembered, as Nichols points out (p. 20), that "strictly speaking, no two spots on the face of the earth have the same climate." Local changes in climate are brought about by the presence of hills, valleys, forests, large bodies of water and by the presence of plants themselves.

2. Physiographic factors. Influences associated with peculiarities in the form, structure and behavior of the earth's surface. So far as we are concerned at present, the principal factors are *a*) topography and *b*) conditions due to the physical or chemical nature of the soil. These things are important since they are directly related to the amounts of water retained by the soil, the amount of light and heat absorbed by the soil and the amount of light, water and minerals available to plants.

2a. Mechanical factors. Purely mechanical influences may be considerable. They include those of heavy winds, hail and ice storms, drifting snow and sand, water currents, wave action and landslides. Mechanical factors may, if desired, be classified partly as climatic and partly as physiographic.

3. Biotic factors. Influences associated with the activity or effect of animals or other plants. The principal factors of this sort are *a*) shade usually brought about by other vegetation that may influence not only light relations but also atmospheric humidity and temperature; *b*) root competition, especially for water; *c*) accumulation of humus through decay of organic matter that may affect directly most of the physical and chemical properties of the soil and so exert a profound influence on the vegetation; and *d*) microorganisms, including both plants and animals.

3a. Anthropeic factors. The influence of man. The great importance of the works of man in modifying the face of the earth can scarcely be overstressed. Swamps are drained, forests cleared, lakes raised or lowered, rivers dredged or diverted, streams dammed up, cliffs blasted away and stock allowed to graze over hills and woods. All other types of habitat factors are strongly modified locally by this one.

4. Pyric factors. Fire not only destroys whole plant communities, but also modifies existing ones through destruction of humus and reduction of shade.

It is thus evident that any plant in any locality is subject to the action of a number of different forces acting upon it simultaneously. The resultant of the factors thus influencing the plant is the environment of the plant. The plant itself, moreover, if it is to survive and flourish, must be adapted to withstand periodic changes, within certain limits, in any or all of these factors. The seasonal changes in temperature, for example, in New York State may be as much as 200° F. at the surface of the ground. The various factors of the environment are so greatly modified locally by each other that an area like Columbia County is not to be thought of as being strictly uniform but as being broken up into many smaller areas, each with its own set of environmental conditions. An example will serve to make this clear:

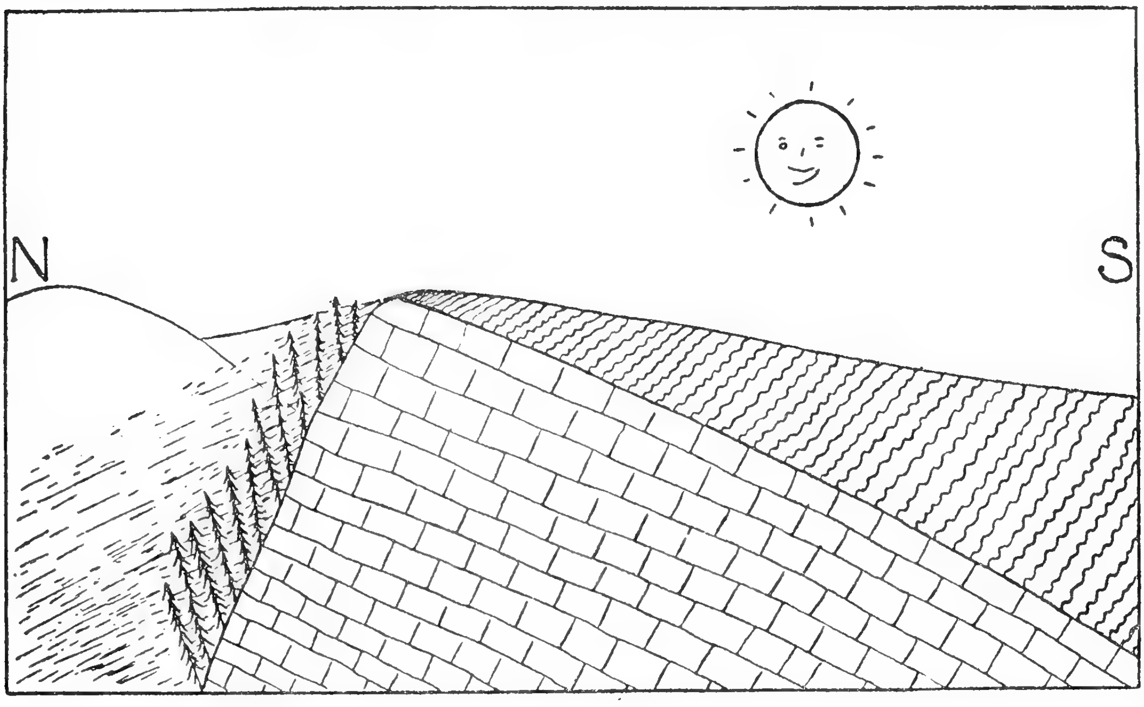

Figure 26. Ideal section through a ridge which has limestones exposed on the steep north face and schists on the more nearly level southern exposure.

Figure 26 represents a section through a hill or ridge which runs east and west, with the northern exposure rather steep and the southern exposure gently sloping or nearly level. As in many localities where the earth's crust has been subjected to much movement, the bedrock is of several kinds; one side (the south) of the hill has an underlying acid schist, while the steeper north side has numerous outcrops of limestone. To the casual observer, conditions would appear to be the same on both sides of the ridge. Upon analysis, however, the following differences appear:

1. The steep north side receives almost no direct sunlight. As a consequence, the air and the soil there remain cooler, moister and more shaded than on the south side. That is, the plants on the north side live in a cooler, moister climate than those on the south side.

2. The prevailing wind is from the north (as is actually the case in many Columbia County localities). As a consequence, plants on that side are more exposed to wind and get somewhat more rain than those on the more protected south side.

3. Erosion is much more rapid on the steep north side than on the other. As a result, plants there are subjected to additional action of water, soil particles and rocks, and to increased leaching out of soil minerals. The soil is better drained than on the south side.

4. Chemical conditions are quite different on the two sides of the hill, as the soil derived from limestone is basic in reaction, while that derived from the schist is strongly acid.

In summation it may be said that on the same ridge, where points due east and west of each other may have identical conditions of temperature, moisture and light, wholly different sets of conditions are established on the north and south sides of the ridge at points a few hundred feet apart.

Along with such local variation in the factors of soil and climate is found a corresponding variation in the kinds of plants making up the vegetation. It is commonly recognized that the relation between the plant and its environment is a most important one. Ecology, the study of this relationship, is a major branch of botanical science. Although it has been known since earliest times that different plants were dependent upon different factors for their continued existence, it is only within recent years that a truly scientific approach has been made to the subject.

In any given habitat or set of living conditions we expect to find plants characteristic of that habitat; that is, species which have become particularly well adapted, through centuries of racial existence, to the conditions prevailing there. We expect to find water lilies in the pond itself, and violets in damp shady places near the pond rather than in the water! Any group or community of plant species which occupy a common habitat may be spoken of as a plant association. Thus simply defined, the number of different kinds of associations depends only on the number of kinds of habitats. A convenient starting point, then, for the study of the vegetation of an area is with the various types of habitats available to plants.

The complicating factor in the study of habitats is the fact that

associations are not static things, but are constantly undergoing a process of change; as conditions of moisture and light are modified by the growth of the plants themselves, and as soil conditions are being changed by deposition of humus and in other ways, the situation may become suitable for new groups of species which then replace the old. Consequently, any given group of species constituting an association is not to be considered a permanent occupant of a certain locality, but merely as one stage in a succession of associations. An example is a sand plain along a stream, which may be at first bare of vegetation and then occupied successively by a group of annual weeds, by perennial weeds and grasses, by shrubs and finally by large trees.

Present conditions of the habitat are, as Nichols says (1923, p. 167), "to a very high degree—a heritage of the past: they represent the cumulative effect of processes and phenomena which not only have originated in the past, but some of which have long ceased to operate. A classification (of plant associations) which takes into account these facts . . . in the minds of many . . . affords the only method by which plant associations may be naturally grouped in their relation to environment." The question may naturally be raised, does such a succession continue indefinitely, or is a stage finally reached where equilibrium is maintained between the association and its environment, so that no further succession takes place? The answer is that in any region a certain climax vegetation is thought to be reached. Under existing conditions of climate and physiography no further succession is thought to be possible. In much of the eastern United States this climax vegetation is a deciduous forest; in midwestern United States it is a grassland; in parts of the western United States it is a desert. In general it may be said that regional climatic factors have the most influence on the development of the climax vegetation, except where local physiographic conditions bring about various local climates and localized habitats.

THE DEVELOPMENT OF THE VEGETATION

When the glaciers receded from eastern New York thousands of years ago there were left exposed large areas which had been denuded of vegetation by the advancing ice. These areas may conveniently be divided into two classes on the basis of moisture present and available for plants. Those habitats in which moisture for plant growth is deficient, either because of high evaporation or low availability or both, are termed xerophytic habitats. This type includes bare rocks and cliffs, and uplands in general. At the end of the

glacial period xerophytic conditions were intensified for several reasons. Evaporation was high, for soils were freely exposed to the sun's rays and there was no shading vegetation. The humus content of some of the soils was low, so that their water-retaining powers were accordingly low. The soils of the uplands were thus doubtless desiccated much of the time.

The other main type of habitat, that in which water is present to excess, is termed hydrophytic. Situations of this sort included depressions of one sort or another, left by the glaciers; such depressions soon filled with water from precipitation or from streams, thus forming lakes and ponds. The hydrophytic habitats also included the saturated margins of these depressions, margins of streams and the streams themselves.

It will be noted that mesophytic habitats, those which show neither an excess nor a deficiency of water, are almost lacking in the picture drawn above. It is a generally accepted concept that succession is toward a more mesophytic condition: that is, with the development of more mature association-types, xerophytic and hydrophytic habitats will become progressively scarcer and more and more of the plants making up the associations will be those adapted to average or median conditions of humidity.

To express the progress of succession in these primary types of habitats, Cooper (1913) introduced the terms xerarch and hydrarch. The former is applied to "those successions which, having their origin in xerophytic habitats . . . become more mesophytic in their successive stages"; the latter refers to "those which, originating in hydrophytic habitats such as lakes and ponds, also progress toward mesophytism." Nichols (1923) proposed to name a third series, the mesarch, "those which originate in mesophytic habitats, such as afforded by moist, rich soils, and in which the vegetation . . . becomes progressively more and more advanced as a result of development. The advance here may take the form, more especially, of increasing complexity." Many ecologists believe that the mesarch series are of more recent origin than the others, as they cannot become established until suitable conditions prevail in the original hydrarch or xerarch series.

DETAILED CONSIDERATION OF THE ASSOCIATIONS

THE HYDRARCH SUCCESSIONAL SERIES AND THEIR PLANT ASSOCIATIONS

1. The association-types of tidal waters.

No plant associations in the Columbia County area are more characteristic than those of the tidal waters of the Hudson River. Although the number of species concerned is relatively small, the number of individuals is large, so that estuarine vegetation is dense over considerable areas.

In our area the estuary varies in width between a maximum of slightly more than 2 km. (opposite North Germantown) and a minimum of slightly more than 0.5 km. of open water (at Hotaling Island) (figure 27). The water is raised and lowered twice daily by tidal action, the variation in level being from 4 to 6 feet (1.2 to 1.8 meters). The water is relatively shallow, except in the main channels, where the depth varies from 20 to 65 feet (6 to 20 meters), the average depths becoming greater southward toward the mouth of the river. For bottom depths at a number of points in our area, the reader may consult Faigenbaum (1935, 1937). The channels are crooked, winding from one side of the river to the other, due in part to the presence of numerous islands and rocky headlands, not to mention many docks and breakwaters, some of which project one-half mile or more into the river (figures 28, 29). The result has been the production of a series of shallow bays and backwaters at various places along the river. At low tide hundreds of acres are exposed as nearly level or gently sloping mud flats (figure 30). According to Lewis and Kinsman (1929) the area of tidal marsh in Columbia County alone is 896 acres.

As Muenscher (1937) has stated, the tidal marsh vegetation is almost wholly limited to shallow bays, shoals and mouths of tributaries, where the water is less than 10 feet deep at high tide. The principal large areas of this kind are as follows: the North and South Bays just south of Tivoli; the north end of Rogers Island and the nearby mainland; the North and South Bays at Hudson; the mouth of Stockport Creek; a bay in the vicinity of Nutten Hook and a similar one just south of Poelsburg; and finally an area at the mouth of the Muitzes Kill. Numerous smaller tidal bays have been cut off by the tracks of the New York Central Railroad, which runs a straight course along the shore and has isolated many small areas which support the characteristic estuarine plants.

Figure 27. The Hudson River, looking southwest from the bluffs about 1 km. north of Poelsburg. Hotaling Island occupies the center of the picture and hides the main channel of the river, which is between the island and the hills in the background. Note the shallow "bay" cut off by the railroad.

Figure 28. A rocky cove on the northwestern side of Crugers' Island, looking north. Magdalen Island may be seen in the distance.

Figure 29. Shale bluffs on the river side of Nutten Hook, looking north.

The vegetation of the region is not influenced to any extent by the saline waters of the Atlantic Ocean. True halophytes are not found in the river north of the vicinity of West Point. Muenscher (1937) mentions two marine algae, *Caloglossa Leprieurii* and *Enteromorpha intestinalis,* which range north to Constitution Island, just above West Point. Among the flowering plants *Spartina alterniflora, Spartina cynosuroides, Juncus Gerardi* and *Lilaeopsis chinensis* have a similar geographic range. The following table shows a correlation between the occurrence of halophytic species, like the above, and relatively high chloride concentration (data from Faigenbaum, 1937, except the linear distances between points):

TABLE 18

Concentration of Chlorides in the Hudson River at Various Points Between Yonkers and Hudson

LOCALITY	APPROXIMATE DISTANCE IN MILES FROM NEW YORK HARBOR	CHLORIDES, PARTS PER MILLION
Yonkers	17	7,040–8,560
Nyack	28	4,210–4,800
Croton Bay	34	2,710–8,520
Haverstraw–Harmon	36	1,710–4,330
Caldwells-Lents' Cove	42	1,700–2,290
Bear Mountain Bridge	45	1,143–1,485
West Point	50	763–1,045
Moodna Creek–Bannerman's Island	56	400 – 900
Newburg–Dennings Point	57	68 – 382
Above Newburg, between Beacon #20 and Brockway	60	18 – 35
Danskammer Point	63	9.5 –11.0
Blue Point to Mine Point	71	3.0 – 4.5
Esopus Island	81	2.5 – 4.9
1¼ miles above Rondout Light	89	2.8 – 5.7
Barrytown	95	3.5 – 5.0
Turkey Point to South Bay (Tivoli)	96	2.2 – 3.8
Above Saugerties	100	4.0 – 5.4
Green Point	107	4.4 – 7.4
Roeliff Jansen Kill	109	2.2
¼ mile below mouth of Catskill Creek	110	4.0 – 4.2
Hudson	114	3.4 – 5.4

The concentration of the river water is seen to vary but little throughout our area. The maximum concentration of chlorides, in parts per million, is about 7.4. The hydrogen-ion concentration of the water is likewise rather uniform throughout, the reaction varying from neutral (pH 6.8 to 7.2) to somewhat alkaline (pH 8.0 to 8.5), but usually standing at a figure between 7.2 and 7.6 (data from Faigenbaum).

The vegetation of the estuarine waters falls into three rather sharply defined groups. The first, comprising a few species but many individuals, includes plants which are wholly submerged, even at low tide. The principal species are:

Vallisneria americana
Najas Muenscheri
Najas minor
Anacharis Nuttallii
Potamogeton perfoliatus

Shallow stagnant channels and depressions are often choked by a thick growth of one or more of these species (figure 31).

The second habitat group is made up of about 10 species of low-growing plants which are exposed on the mud flats at low tide but are submerged or nearly so at high tide:

Isoetes riparia
Sagittaria Eatoni
Sagittaria subulata
Eriocaulon Parkeri
Heteranthera dubia
Heteranthera reniformis
Elatine triandra var. *americana*
Limosella subulata
Hemianthus micranthemoides
Lindernia dubia var. *inundata*

These plants are found mostly in small colonies scattered about on the otherwise bare wet mud exposed at low tide. Individual plants of other species, such as *Orontium aquaticum,* may be intermingled with them, but in general the plants of this zone are small and low-growing and rarely form a dense association. When the mud flats are nearly level, so that broad expanses are exposed at low water, the association is best developed. Where the shores are steeper and the line between the tide levels is narrower, these plants are often found in company with the larger species of the next group.

The third group of species gives the characteristic aspect to the tidal marshes. They are for the most part tall plants, so that at least their tops are above water even at high tide. The dominant species are again few in number, but large in number of individuals, so that dense pure stands are sometimes formed over hundreds of acres. The species involved are:

Equisetum fluviatile
Typha latifolia
Typha angustifolia
Sparganium eurycarpum
Sagittaria latifolia
Sagittaria rigida
Zizania aquatica
Scirpus fluviatilis
Peltandra virginica
Orontium aquaticum
Pontederia cordata
Acnida cannabina
Nuphar advena
Sium suave
Stachys tenuifolia
Bidens bidentoides
Bidens connata
Bidens hyperborea
Bidens Eatoni
Helenium autumnale

Figure 30. Tidal flats along the Hudson River at low water. The land across the channel is Rogers Island and in the middle distance is the Rip Van Winkle Bridge.

Figure 31. One of the channels near the mouth of Stockport Creek, at low tide. The exposed areas are thickly covered by aquatics.

Figure 32. The line of demarcation between the zone occupied by *Nuphar* and that occupied by *Zizania,* on the shore of the Hudson east of Rogers Island. The tops of the water lilies are barely covered by water at high tide.

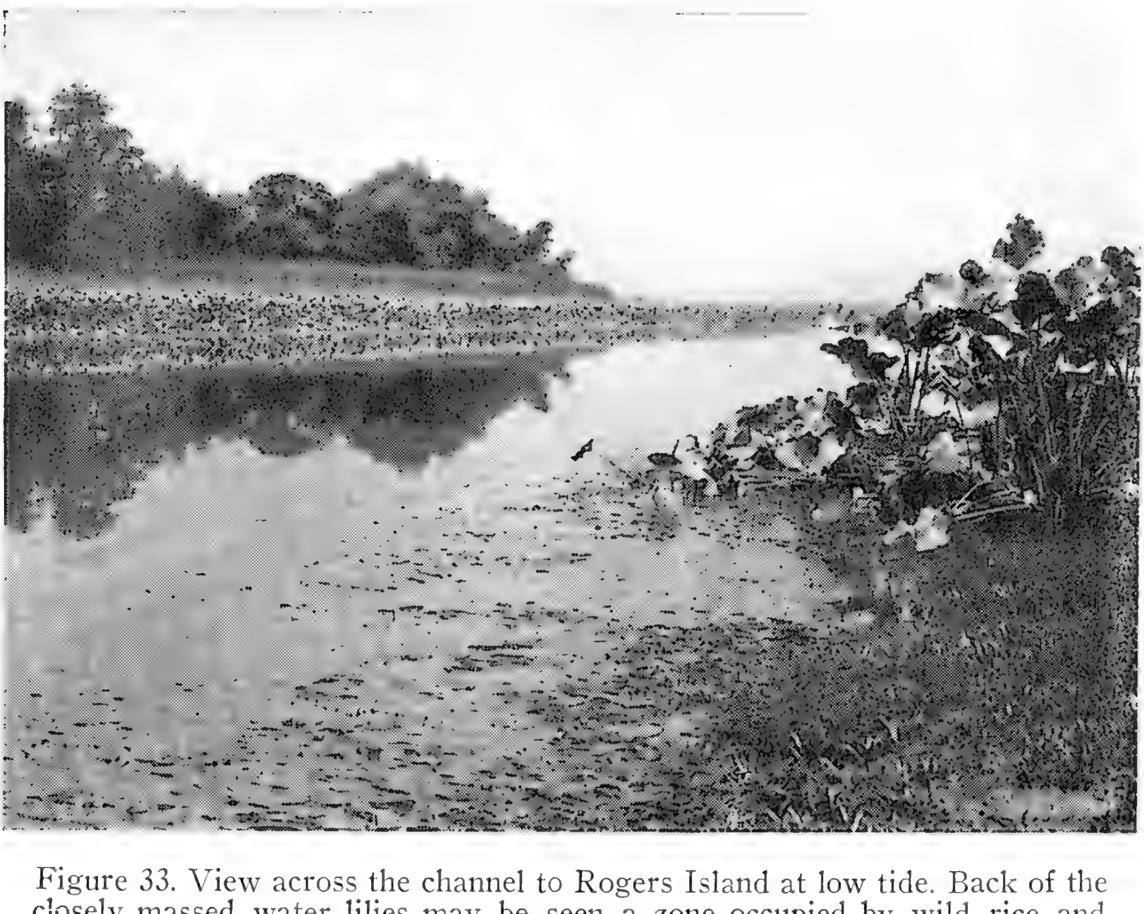

Figure 33. View across the channel to Rogers Island at low tide. Back of the closely massed water lilies may be seen a zone occupied by wild rice and sedges *(Scirpus fluviatilis).*

The most abundant plants, by far, are the wild rice, *Zizania,* and the yellow water lily, *Nuphar.* The river sedge, *Scirpus fluviatilis,* or the cattail, *Typha latifolia,* is next in abundance. Either *Zizania* or *Nuphar* may occupy large areas to the practical exclusion of other species (figure 15, p. 113), while the two other dominants are more often associated with other vegetation and less often form pure stands.

A remarkable zonation is often visible along the channels of the river. Following the zone of mud plants which are submerged at high tide there is in many cases a closely succeeding zone made up wholly of *Nuphar.* Immediately following this may be *Zizania* (figures 32, 33) or a mixture of *Zizania* and *Scirpus.* The line of demarcation is apparently set by the slope of the substratum. *Nuphar* seems capable of existing and thriving in wetter situations than the other plants, whereas it is incapable of competing with them where the ground is slightly higher. As the ground becomes higher and the water at high tide shallower, other species make their appearance, so that nearer shore an almost impenetrable growth of *Scirpus, Typha, Sagittaria latifolia, Peltandra, Acnida, Stachys* and *Equisetum* is found. The dominant vegetation is usually 2 to 3 meters high (*Zizania, Scirpus, Typha*).

Under natural conditions in the estuary, succession was probably rather slower than at present. The influence of the tides tends to exclude many species, and land building is relatively slow because of the wash of the tidal waters. Under present conditions, however, it is possible to observe a rapid succession in many of the "bays" and shallows which have been cut off from the main part of the river by the railroad (figure 27). The railroad was put through about the middle of the last century, and men now living can remember when the North and South Bays below Tivoli were open water. The same thing applies to the "bays" above and below Hudson. As late as the 1880's and 1890's these are said to have supported little vegetation and to have been open bodies of water. At present, however, the Tivoli bays are nearly filled with the tall and aggressive perennials just discussed. The mass of vegetation is intersected here and there by narrow channels, but most of the area is now dry enough to walk over at low water. These large bays, which are nearly a kilometer wide and each over a kilometer long, have thus been filled by sediments and root growth in a relatively short time. A similar fate has overtaken the Hudson bays (figure 34).

In somewhat dryer soil, nearly out of the influence of the tides, a further stage in succession is evidenced by the abundance of semi-amphibious plants like *Peltandra, Orontium, Acnida,* and the vari-

ous species of *Bidens*. In this zone appear also such plants as *Spartina pectinata, Stachys tenuifolia* var. *platyphylla, Teucrium canadense* and *Lobelia Cardinalis*. Some shrubs, particularly *Alnus serrulata Physocarpus opulifolius, Cornus Amomum* and *Cornus alternifolia,* grow nearly or quite in the water at high tide.

Above high tide level shrubs and trees usually are abundant, including not only those named above but *Ulmus americana, Fraxinus pennsylvanica, Fraxinus nigra* and *Acer rubrum*. Characteristic herbaceous plants of this zone are *Cassia hebecarpa, Gaura biennis, Gentiana Andrewsii, Heliopsis helianthoides* and *Ambrosia trifida*.

Where tidal marshes are more or less level and extensively developed, as at Rogers Island, the succession goes through a swamp-forest stage dominated by *Ulmus americana, Acer rubrum, Fraxinus pennsylvanica* and *Fraxinus nigra*. On Rogers Island, the "white cedar," *Thuja occidentalis,* occupies a conspicuous place in the association. The forest floor is always wet, with a number of tidal channels breaking up the island into smaller areas. The principal species under the trees are the two dogwoods referred to above, *Cephalanthus occidentalis, Smilax tamnoides, Physocarpus, Mikania scandens* and *Lathyrus palustris* var. *myrtifolius*.

At Hotaling and Schodack Islands the land level is somewhat higher and this swamp forest is replaced by one of slightly different composition. Dominant here are *Ulmus americana, Acer saccharinum* and *Acer rubrum,* with a considerable admixture of *Fraxinus nigra, F. americana, F. pennsylvanica, Platanus occidentalis, Quercus bicolor, Populus deltoides* and *Salix nigra*. The islands are notable for the absence of gymnosperms and of the group of species with southern affinities which occur on Rogers Island (e. g. *Smilax tamnoides, Mikania,* etc.).

When Kalm visited Albany in 1749, he spent a short time on one of the islands below the city. His account of it shows conditions not greatly different from those prevailing today:

> An Island near Albany. This afternoon (June 19, 1749) I went to see an island which lies in the middle of the river about a mile below the town. This island is an English mile long, and not above a quarter of a mile broad. It is almost entirely turned into plowed fields. . . . Here we saw no woods, except a few trees which were left round the island on the shore and formed as it were a tall, large hedge. The red maple (*Acer rubrum*) grows in abundance in several places. Its leaves are white or silvery on the under sides and, when agitated by the wind, they make the tree appear as if it were full of white flowers. The water beech (*Platanus occidentalis*) grows to a great height and is one of the best shade trees here. The water poplar is the most common tree hereabouts, grows exceedingly well on the shores of the river,

Figure 34. The "South Bay" at Hudson, looking north toward the city. Open water formerly extended to a point not far from where the picture was taken.

Figure 35. Gravelly beach on the northwestern side of Crugers' Island showing almost total lack of vegetation. Note that at left the cliffs come down almost directly into the water.

Figure 36. A view across one of the lakes of Columbia County (Fowlers' Lake). Note that the swamp forest on the farther shore extends almost to the water's edge, with but a slight intervening shrub zone.

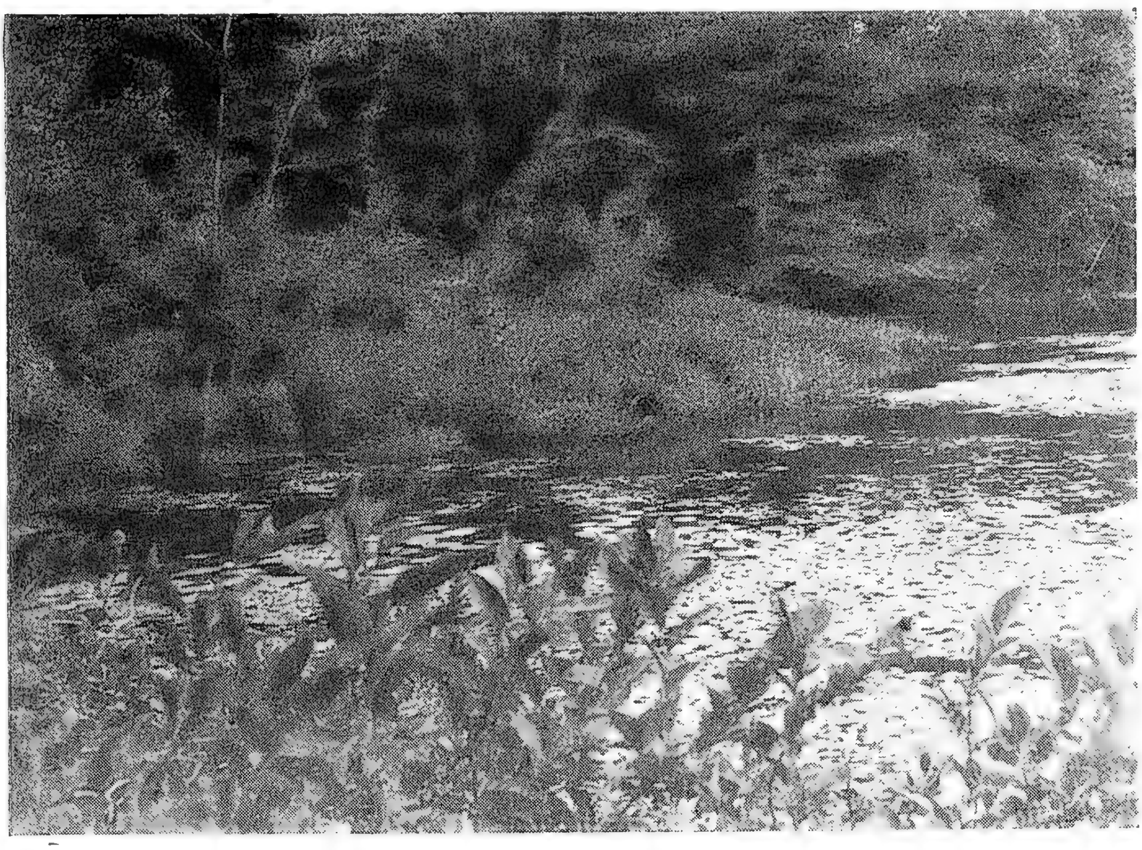

Figure 37. Floating-leaved aquatics at the north end of Upper Twin Pond, Elizaville. Most of the floating leaves are those of pondweeds *(Potamogeton* spp.).

> and is as tall as the tallest of our aspens. . . . The wild plum trees are plentiful here and full of unripe fruit. . . . Sumach (*Rhus glabra*) is plentiful here, as also the wild grapevines which climb up the trees and creep along the high shores of the river. . . . The American elm tree (*Ulmus americana*) forms several high hedges. The soil of this island is a rich mould, mixed with sand, which is chiefly employed in corn plantations. (Benson, vol. 1:338. 1937).

Where the tidal marsh succession goes through a series from mud flats to sandy beach to gravelly beach to boulder beach, the stages deserve separate consideration.

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2. The association-types of lakes and lake swamps.

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tually reach the climax indicated by climatic conditions; that is, a pine-hemlock-hardwood forest.

On the other hand, it is quite possible that the present low shrub association is a more or less permanent physiographic climax. Under natural conditions succession is apparently slow. There is no evidence that the communities of *Arctostaphylos-Potentilla-Aronia-Amelanchier-Prunus* have been disturbed within historic times. The first two in particular are known throughout their ranges as plants of exposed rocky summits, and it is highly improbable that either could have existed within the limits of any densely forested area. It is equally improbable that the association could have invaded the area *in toto* since the removal of the forest by the white man. In the absence of definite information as to the original covering of these rocky summits, then, it is probable that the present vegetation represents the highest stage of development that has been reached since the retreat of the glaciers.

c. Where the outcrops are shale. In the Hudson Valley shale is the prevailing type of substratum, and it outcrops frequently, forming exposed ridges and hills as well as actual bluffs. The steeper bluffs are found for the most part at or near the Hudson River, where they are represented on many of the islands and at several points on the mainland (figure 29); they may be accompanied by cliffs of considerable height. A second type of shale exposure is the kind well illustrated at Blue Hill, in the town of Livingston, where the slopes are steep and rocky without the formation of actual cliffs. Finally, associated throughout with the areas of the Cossayuna soils are numerous north-south ridges, varying in height from a few feet to several hundred feet, with the summits or sides exposed for short distances or covered with very shallow soil (figure 54). In all the shale outcrops there are certain similarities in physical conditions. The shale itself is relatively soft and disintegrates easily, forming crumbly, irregularly rounded exposures and but few vertical cliffs. Talus formation is extensive, but due to the crumbly nature of the shale the slopes are not composed of large blocks, as usual on limestone and quartzite or schist slopes; rather, the slopes are composed of small fragments which form an unstable, steeply sloping substratum (figure 55).

The areas surrounding the shale outcrops in Columbia County are for the most part forested, although many of the small exposures associated with the Cossayuna soils have been entirely cleared and are now in fields or pastures. The usual forest type is the "dry woods" described above as characteristic of many of the glacial soils in our region but with the addition of a considerable amount

of *Celtis occidentalis,* the hackberry. White pine, pitch pine and hemlock are usually present, along with an abundance of sugar maple, and the development of the climatic climax seems only a question of time. Usually a few shaly ledges in any given locality are not covered by woodland, and these ledges support an interesting association of plants which are not tolerant of shade to any extent.

The unstable nature of the shale makes uneven slopes and frequent crevices, and, as a result, the exposed surfaces are usually occupied chiefly by strongly rooted biennials or perennials, e.g.:

Woodsia obtusa
Woodsia ilvensis
Aquilegia canadensis
Arabis lyrata
Saxifraga virginiensis
Rhus aromatica
Penstemon hirsutus
Campanula rotundifolia
Solidago squarrosa

On more or less level exposures, where shallow soil exists in small patches, three species are usually associated: *Cyperus filiculmis, Polygonum tenue* and *Selaginella rupestris.* These three occur also on the more stable places on the talus slopes in company with other species. This small association gives way in deeper soil to a more inclusive one dominated by *Andropogon scoparius* and other species, including *Panicum linearifolium, Carex pensylvanica* and the semi-weedy goldenrods, *Solidago nemoralis* and *S. juncea.* This association is often invaded by juniper (*Juniperus virginiana*), followed by white pine and other trees of the forest. Juniper is the usual pioneer species near the Hudson River, as may be seen at Mount Merino and Blue Hill, and is often accompanied by the hackberry. Farther inland, a far more common pioneer is the gray birch, *Betula populifolia.*

8. The association-types of talus slopes.

The vegetation of talus slopes is treated in a separate section rather than in connection with the accompanying rock outcrops since the vegetation of the slopes is generally much more mesophytic than that of the cliffs or bluffs from which they have been derived. This is true except in the case of the shales, where the rocks themselves in some cases are intermingled with interrupted slopes of disintegrated rock and the floras of the two also intermingle to some extent. The effects of soil conditions upon the character of the vegetation are often minimized by physiographic ones, so that talus from a limestone cliff may support much the same plant community as does that derived from an acidic rock. The similarity of vegetation in such cases seemingly is induced by the sheltered nature of the habitat, by good drainage, or by a combination of both.

Figure 34. The "South Bay" at Hudson, looking north toward the city. Open water formerly extended to a point not far from where the picture was taken.

Figure 35. Gravelly beach on the northwestern side of Crugers' Island showing almost total lack of vegetation. Note that at left the cliffs come down almost directly into the water.

Figure 36. A view across one of the lakes of Columbia County (Fowlers' Lake). Note that the swamp forest on the farther shore extends almost to the water's edge, with but a slight intervening shrub zone.

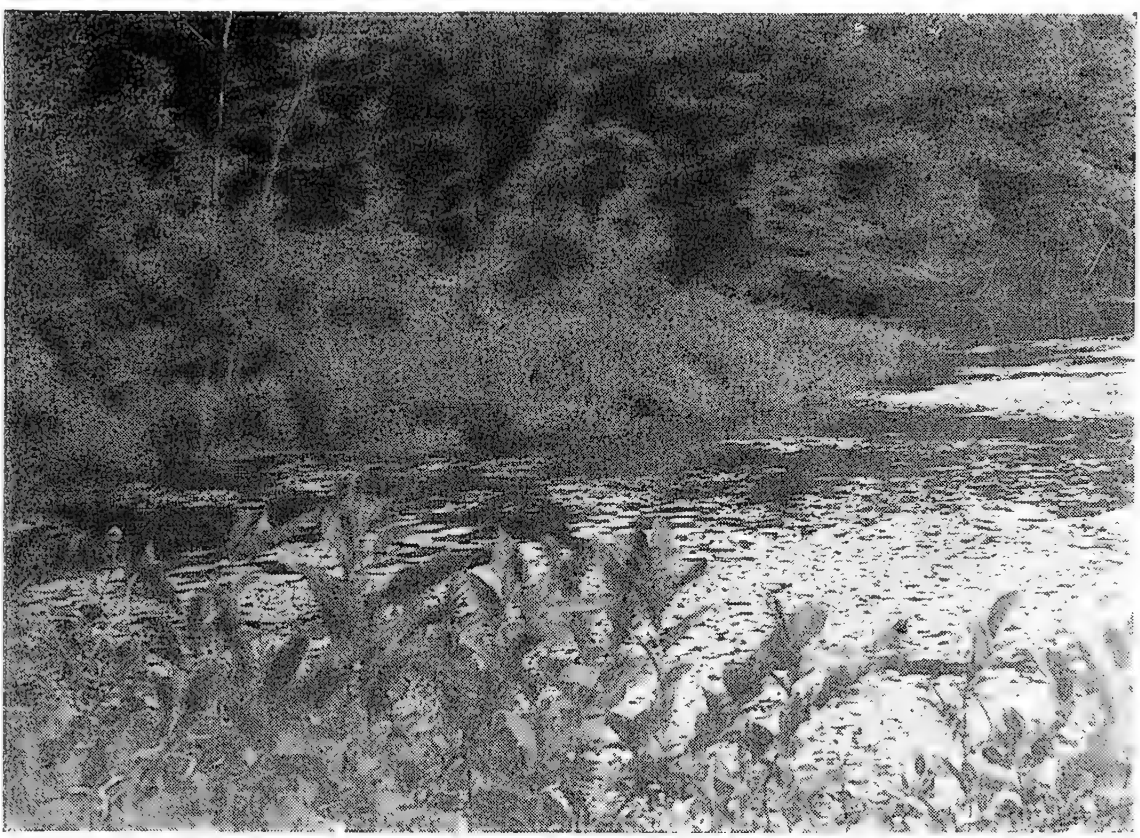

Figure 37. Floating-leaved aquatics at the north end of Upper Twin Pond, Elizaville. Most of the floating leaves are those of pondweeds *(Potamogeton* spp.).

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TABLE 19

LAKES AND PONDS

NAME	AREA IN SQUARE MILES	DEPTH IN FEET	pH	OXYGEN, PARTS/MILLION	
				Surface —10 ft.	10—20 feet
Copake Lake........	0.57	34	7.2—7.6	6.9—7.6	5.1—6.0
Kinderhook Lake....	0.28	22	7.3—7.9	5.3—9.2	4.5—5.3
Taghkanic Lake.....	0.25	41	6.6—6.8	7.0—7.4	5.0—6.8
Tackawasick Lake....	0.21	38	6.0—6.8	7.6	1.1—7.6
Robinson Pond......	0.14	..	....	....	....
Queechy Lake.......	0.14	44	8.4	8.0—9.2	8.8
Rhoda Pond (upper)..	0.11	46	8.2—8.4	8.0	7.6—8.0
Rhoda Pond (lower)..	0.10	57	8.4—8.6	(8.2—14.0)	
Bells' Pond.........	0.09	..	....	....	....
Smith Pond.........	0.06	7*	7.5—7.6	3.7—6.8	....
Knickerbocker Lake..	0.06	36	7.4—8.4	7.0	2.7—3.4
Chrysler Pond.......	0.05	..	8.6—8.7	7.5—8.9	....
Forest Lake.........	0.05	..	....	....	....
Long Pond (Ancram).	0.04	..	....	....	....
Miller Pond (Ancram)	0.04	..	....	....	....
Snyder Pond........	0.04	..	....	....	....
Taplins' Pond.......	0.04	..	....	....	....
Twin Pond (upper)...	0.04	88	7.0—7.6	5.6—8.8	5.6—1.?
Twin Pond (lower)...	0.04	..	....	....	....
Sutherland Pond.....	0.03	..	8.0 (surface*)	....	....
Bachus Pond........	0.01	18	6.4—7.6	7.7	?? —0.0
Barrett Pond........	0.01	..	....	....	....
Fowlers' Lake.......	0.01*	15*	....	....	....
Merwins' Lake.......	0.01*	12*	8.0 (surface*)	....	....
Mud Pond..........	0.01*	..	....	....	....
No Bottom Pond....	0.01*	6*	9.0*	....	....
Waldorf Pond.......	0.01*	17*	....	....	....

Total area, lakes and ponds: 2.45 square miles (1,568 acres). The areas in the above table are taken from Douglas (1928) except those designated by an asterisk (*); depths, except those marked by an asterisk, are from the New York State Biological Survey reports (1935, 1937). The pH values, except those marked with an asterisk, are from Faigenbaum (1935, 1937); oxygen concentration values are from Faigenbaum.

that a fair estimate can be made of the original surroundings of all of them.

The preceding table lists the principal bodies of water in the Columbia County area, together with the surface area of each, and, where known, the greatest depth, acidity value of the water, and concentration of dissolved oxygen. Certain of the lakes in Rensselaer County, in the northern part of the area, have been omitted for lack of data.

The pH values indicate that in general the waters are neutral or alkaline; the alkalinity is greatest in the lakes of the calcareous areas of the eastern part of our region. None of the lakes has an acidity value greater than that of pH 6.0, and most of them have an acidity equal to that of pure water (pH 7.0) or less, ranging to an extreme of pH 9.0 (1/100th as acid as pure water). Oxygen concentration of at least five parts per million may be expected at depths of 20 feet (6 meters) or less, except in a few cases. This is sufficient to support plant and animal life. At greater depths the oxygen concentration decreases rapidly.

The turbidity of lake water bears an important relation to plant life, as plants cannot become established in situations where there is less than a certain minimum amount of sunlight. For the most part, the lakes and ponds discussed above are not true "clear water lakes." Although there may be partial visibility to depths of 15 or 20 feet (4.5 to 6 meters), especially in the larger bodies of water, the figure is probably less than this in the majority of cases. Much of the turbidity is caused by organic matter in finely divided particles; in some lakes which are poorly drained and have a high content of organic matter, like Fowlers' Lake and Mud Pond, visibility may be less than 1 meter; the water is slightly brownish in color and not wholly clear. In such lakes submerged aquatics are usually not abundant and may be practically nonexistent at depths of more than 1 meter. It is to be expected, then, that plant life, in most of the lakes of this area, will be limited to depths of 6 meters or less; the limiting factors will be either content of dissolved oxygen in the water, the amount of sunlight available, or both. This conclusion is confirmed by field studies, which show that in the lakes the beds of vegetation are confined almost wholly to places where the water is less than 3 meters in depth and are rarely found at depths as great as 6 meters. For maps of several lakes, showing "weed beds" or areas of dense aquatic vegetation, see Odell (1935, pp. 106-8).

Plant succession in lakes and ponds has been much studied and commented upon. In general, the process is thought to be as follows: wherever conditions are favorable plants may be found grow-

ing wholly submerged. As the plants grow from year to year, their partially decomposed dead leaves and stems accumulate and form humus, so that a mucky soil is formed on the bottom of the lake. The stems of the living plants act as barriers to debris of various kinds carried by water currents, so that sedimentation is more active than in plant-free waters. As a result, the bottom of the lake is built up, the depth of the water is decreased and a rich organic substratum is formed. When the lake bottom has reached a level of a meter or so below the surface of the water, the soil is invaded by rooted aquatics with floating leaves; in still shallower water plants like sedges and cattails appear, with just their bases submerged. Theoretically the process of building up continues indefinitely; shrubs and finally trees invade the sedge zone as sedimentation and soil-building progress. Finally, if the time be long enough or the pond small enough, the water becomes so shallow that the floating-leaf association-type drives out the wholly submerged type, and is in its turn driven out by the sedges and swamp forest; the ultimate result is the appearance of the climax forest over the whole area formerly occupied by lake. In different localities the species concerned in the succession may be wholly different, but the principles involved, as well as the association-types, will be identical. Some ecologists, including Weaver and Clements (1929), distinguish between the successional series in lakes, where drainage is good, and that in bogs, where drainage is relatively poor, with consequent poor aeration and often high acidity. In the Columbia County area no such sharp distinction seems possible. Characteristic bogs, with accompanying high acidity and peculiar flora, may be found in one part of a lake, while at the other end of the same lake the successional series identified with well drained localities may be developed. While this is perhaps not universally true, the bogs here seem to represent the more advanced stages of the successional series. At Knickerbocker Lake, for example, one side (the north) has a well formed association like those usually thought of in connection with alkaline or well drained waters. The abundant species are *Anacharis Nuttallii, Najas flexilis, Najas guadalupensis, Ceratophyllum demersum, Potamogeton illinoensis* and species of stoneworts (*Chara* spp.). The beaches are gravelly and rather steep, so that there is little emersed vegetation. On the south side of the same lake, however, in an extensive shallow bay, emersed or floating-leaved aquatics are dominant: *Typha latifolia* and *Nymphaea odorata* are the principal species in water 0.6 to 1.2 meters deep. Nearer shore the cattail-water lily community is being invaded by a semifloating sphagnous mat, accompanied by a mixed assortment of acid-loving

and lime-loving plants, as well as marsh plants indifferent to soil reaction. The reaction in the sphagnum mat may be as acid as pH 5.0, while the lake water that oozes up through it may have a pH of 7.0.

Such examples may be multiplied, but all lead to the conclusion that in the present study no definite line should be drawn between associations of lakes and those of bogs. In general it may be said that bogs tend to develop where there are large bays or other areas of shallow water, and it may well be that the various stages of the succession have simply been telescoped, so that the "bog-associations" appear earlier than would be the case if the lake bottom were steeper. Evidence seems to point strongly to the conclusion that bog formation and the appearance of the peculiar bog vegetation are both to be associated with local accumulation of large amounts of humus, and that this may occur sooner in one part of a lake than in another, depending upon local physiographic conditions. While the sphagnum-bog stage may be omitted in the successional series toward the climax forest, at least in some parts of a given lake, there is probably no natural body of water in the Columbia County area where at least the beginning of such a stage cannot be observed.

The pioneer plants of lakes, the submersed aquatics, consist for the most part of several species of pond-weed, *Potamogeton*. In the deeper waters, that from 3 to 4.5 meters in depth (or less in the "muddiest" lakes), the most abundant species are *P. praelongus, P. zosteriformis, P. amplifolius* and *P. illinoensis*. In most cases these are associated with hornwort, *Ceratophyllum demersum*, and less often with *Anacharis canadensis*. In slightly shallower water, that of 2 to 3 meters in depth or slightly less, the above species are at least partially replaced by *Potamogeton natans, P. nodosus, P. Spirillus* and *P. gramineus*. At this depth occur also the yellow and white water lilies, *Nuphar advena* var. *variegatum* and *Nymphaea odorata*, which are ubiquitous in this zone in our lakes and are usually very abundant. These two species usually dominate a considerable area near the shore, due partly to their strong rhizomes which enable them to spread readily when once established, and also to their large floating leaves, which may completely cover the surface of the water and shade out less aggressive species. Where the water lilies are not too abundant, they may occur in a mixed association with *Potamogeton natans, Anacharis canadensis, Ceratophyllum* and, in shallower water, *Najas flexilis* (figure 37). Where the floating leaves of the water lilies form too dense a shade to allow competition, they may form an almost pure stand. Further-

Figure 38. Water lilies *(Nymphaea odorata)* growing in small areas of open water in a sphagnum bog near Knickerbocker Lake. The shrub-like vegetation surrounding the areas of open water consists for the most part of two species, *Chamaedaphne calyculata* and *Decodon verticillatus*.

Figure 39. Water lilies *(Nymphaea odorata)* in a sphagnum-filled depression (the "Fingar Marsh") about 3 km. south of Taghkanic Lake. This is apparently a somewhat later stage of succession than that represented in figure 38.

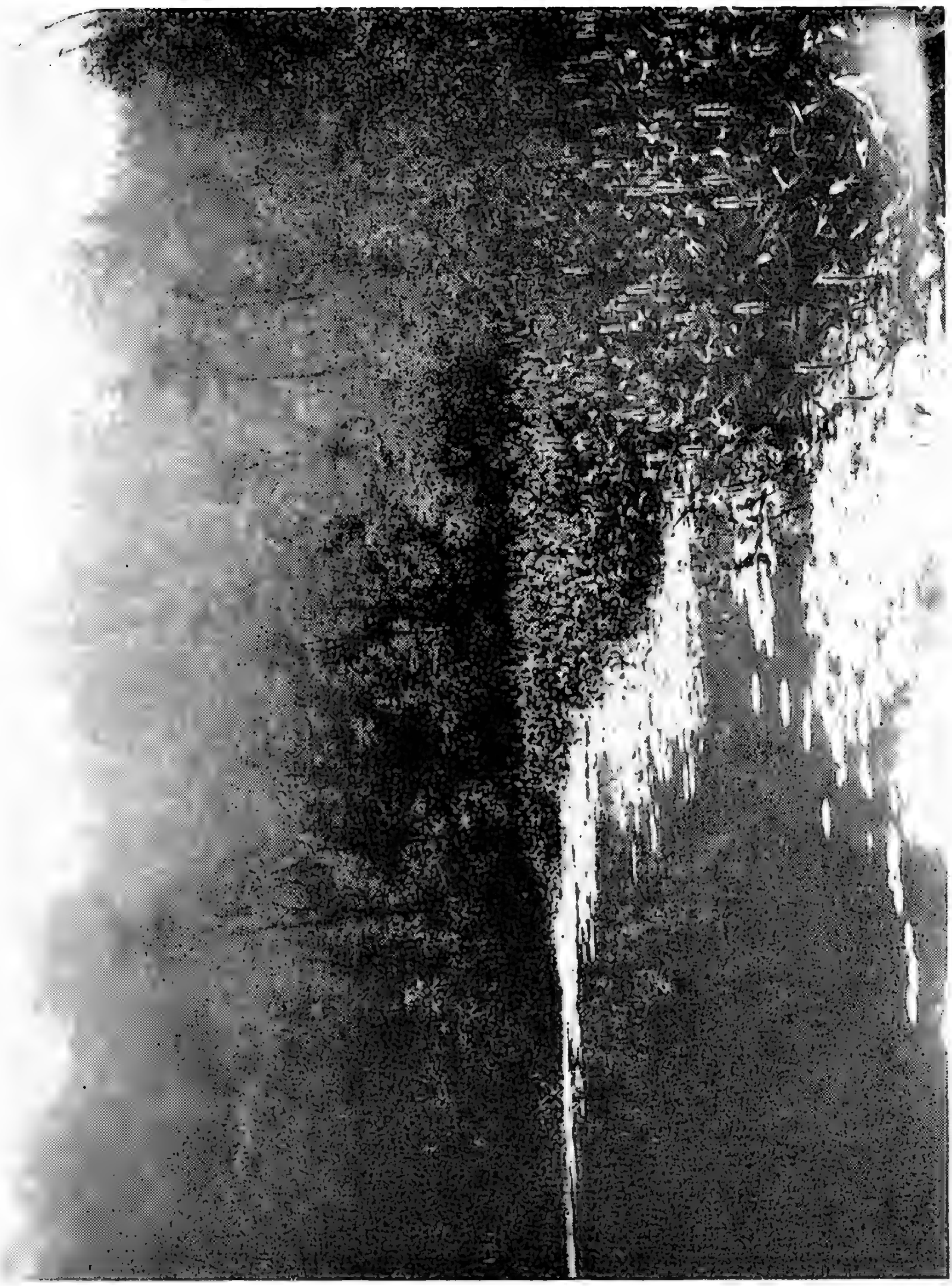

Figure 40. Marginal herbaceous vegetation at Fowlers' Lake. Note the intermediate zone of *Pontederia cordata* (in flower) between the water lilies and the zone of shrubs.

more, they are seemingly not sensitive to changes in hydrogen-ion concentration, and may often be found as the last survivors, in highly acid bogs, of the floating-leaf association-type (figures 38, 39).

The conventional "reed-swamp" and "sedge-meadow" stages of succession, which are ordinarily supposed to follow and invade the association of floating-leaved aquatics (discussions of which may be found in any textbook on ecology), are not well represented in our region. If the bank of the lake or pond be relatively steep the forest usually comes to the very edge of the water (except where the land is used for pasture or has been cleared for other purposes). If the land about the lake be low and poorly drained it is usual to find the floating-leaf stage succeeded directly by a zone of shrubs or by a sphagnum bog, sometimes with an intermediate zone of *Pontederia cordata* (figure 40) or locally with small areas of mixed associations of *Typha, Sparganium americanum, Peltandra virginica, Calamagrostis canadensis* and a few other species.

At the edge of the water the most conspicuous species are three shrubby or half-shrubby plants, which individually or together dominate the association: *Chamaedaphne calyculata, Decodon verticillatus* and *Alnus serrulata.* Less often *Acer rubrum* and *Vaccinium corymbosum* appear with the others as does the marsh fern, *Dryopteris Thelypteris.* Back of this shrubby margin the succession may develop directly through a tall shrub zone dominated by *Alnus serrulata, Vaccinium corymbosum, Acer rubrum, Rhus Vernix, Lyonia ligustrina, Spiraea latifolia, Cornus Amomum, C. stolonifera* and *Solanum Dulcamara.* Other shrubs which play an important part on most of the lakes are *Alnus rugosa, Rhododendron viscosum* and *Gaylussacia baccata.*

The undergrowth of the tall shrub association is usually rather scanty; the zone where it occurs is poorly drained and the ground underneath is often saturated. Sphagnous areas occur frequently, and dense tufts of *Osmunda cinnamomea* and *O. regalis* cover much of the ground. See figure 41; the swamp forest here is more mature than that just discussed, but the fern covering is very characteristic and doubtless inhibits the growth of many low-growing species.

The width of the tall shrub zone is governed by the drainage. On slightly higher ground the zone is succeeded gradually by the swamp forest, in which the dominant trees are *Acer rubrum, Fraxinus nigra, Quercus bicolor, Ulmus americana, Fraxinus americana* and *Pinus Strobus.* These are given in approximate order of abundance. The understory of shrubs is made up of *Lindera Benzoin, Alnus serrulata, Rhus Vernix* and *Rhododendron viscosum,* as well

as the semishrubby *Rhus Toxicodendron, Rubus hispidus* and *R. pubescens.* The herbaceous vegetation is dominated by *Osmunda cinnamomea* and *O. regalis,* which in many cases are taller than the lower shrubs; also abundant are *Dryopteris spinulosa, D. cristata, Symplocarpus foetidus* and *Boehmeria cylindrica.*

In some localities the development is slightly different from that just described. Just back of the wet marginal zone of *Decodon* and *Chamaedaphne* a strong growth of sphagnum may prevent the development of the shrub zone in its most typical form. Scattered plants of *Lyonia, Vaccinium, Gaylussacia, Chamaedaphne* and *Nemopanthus mucronata* usually occur in the sphagnum mat. Farther from open water, where the mat is firm enough to support a man, a zone of more or less open sphagnum may occur. Here the principal species are the following:

Eriophorum virginicum	*Sarracenia purpurea*
Eriophorum viridi-carinatum	*Drosera rotundifolia*
Rhynchospora alba	*Kalmia angustifolia*
Carex canescens var. *disjuncta*	*Vaccinium Oxycoccos*
Pogonia ophioglossoides	*Vaccinium macrocarpon*

Other sphagnophilous species occur sometimes, including *Carex limosa, Calopogon pulchellus, Kalmia polifolia, Andromeda glaucophylla* and *Eriocaulon septangulare.* In almost any bog of this kind may be found a few individuals of tolerant species which seem to be "leftovers" from preceding open-water stages: *Peltandra virginica, Scirpus validus* and the water lilies mentioned above are the best examples (see figures 38, 39).

In three or four localities in our area there are "typical" bogs as described by some ecologists, where the sphagnum zone is dominated by *Picea mariana* and *Larix laricina.* These are not found at any bodies of water large enough to be called lakes. Taplins' Pond, in Stephentown, was the largest example, but it is now flooded. The others are small potholes, now practically filled with sphagnous mat (figures 42, 43). The locality near Knickerbocker Lake (figure 42) still has a small area of open water in the center. This locality shows clearly the succession following the spruce-larch stage. The dryer parts of the bog are invaded by red maple and American elm, which soon crowd out the conifers. The larch is the more resistant to shading, but it never competes on an equal basis with the deciduous trees, as is evidenced by the dead larches, 6 inches (15 cm.) in diameter or less, standing among the larger elms and maples only a few meters from the open bog where both larch and spruce are thriving.

Figure 41. Swamp forest at Mud Pond, about 5 km. east of Elizaville. The tree immediately beside the boy and those just behind him are black gum, *Nyssa sylvatica.*

Figure 42. Sphagnum bog near Knickerbocker Lake, showing spruce and larch and characteristic shrub vegetation. The white objects in the center of the picture are the cottony heads of *Eriophorum virginicum*.

Figure 43. The "Fingar Marsh," Gallatin, a depression which is practically filled with sphagnum and the associated bog plants. The level space in the foreground is covered by a mat of vegetation into which one sinks to the knees in water.

Summary of the above evidence indicates that the swamp forest, dominated above all by *Acer rubrum* and *Ulmus americana,* develops relatively quickly in most of the poorly drained areas about our lakes. There is some evidence, however, to show that this is not a climax type. White pine is present in almost all such swamp forests, at least in small amounts, and penetrates even the most acid sphagnum bogs, where, however, it does not thrive. Study of the remnant of a mature swamp forest of this kind near New Britain, in the town of New Lebanon, leads me to think that pine-hemlock forest represents the last stage in development of the lake swamp. The tall shrub and deciduous forest stages here at New Britain give way to a mixed stand of *Pinus Strobus* and *Tsuga.* The ground cover, except in the clearings where sphagnous hummocks are strongly developed, is sparse. The abundant species are *Aralia nudicaulis, Clintonia borealis, Maianthemum canadense, Coptis groenlandica* and *Trientalis borealis,* with some *Cornus canadensis.* This association-type approximates that described below (p. 368) as the climax forest for the Columbia County area. Clearing of the forests has made the region in general more xerophytic, so that this mesophytic forest is now rarely seen, but it is probable that such a type was once widespread in the Hudson Valley. Larsen (1922) gives actual figures for the changed conditions brought about by cutting of virgin white pine forests in Idaho. His data show that the uncut forest provides a stable habitat, where fluctuations in temperature are very small and where evaporation is less than half as much as in the clearings. The plants which disappear from the Idaho clearings are closely similar to or identical with the ones thought to have been widespread in the climax forest of Columbia County: mostly low evergreen herbs, including *"Coptis trifoliata, Cornus canadensis, . . . Aralia nudicaulis."*

One lake in the Columbia County area deserves special attention, as it is quite different from any other lake studied. This is No Bottom Pond (figure 44), which is a small, roughly triangular body of water situated in the northeastern part of the town of Austerlitz at an altitude of about 1,570 feet (471 meters) above sea level. It is not fed by springs or streams except by intermittent drainage from the surrounding hills, so that it attains its maximum depth of somewhat more than 2 meters in the spring after the snow has melted. In dry summers the water may disappear entirely, which is evidently the source of the name, "No Bottom Pond." The bottom is rocky, with gently sloping rocky or gravelly shores, and is covered for the most part with several inches of mucky clay soil.

The vegetation, as might be expected in a body of water with so great a fluctuation in level, consists of a few relatively adaptable species. Almost the entire bottom is covered with a dense turf of *Isoetes riparia,* with numerous scattered plants of *Sagittaria graminea, S. cuneata, Najas flexilis* and *Potamogeton gramineus,* while around the edges of the lake, on the gravelly or muddy shores, are found quantities of *Ranunculus reptans* var. *ovalis, Polygonum amphibium, Glyceria Fernaldii, Hypericum boreale* and *Fimbristylis autumnalis.* The pond itself occupies a depression exactly on the line between the limestone strata of the Canaan area, which reach their southern limit here, and the schists which occupy much of Austerlitz. Accordingly, the northern, rocky shore of the pond is of limestone rocks and the water is highly alkaline (pH 8.0-9.0). The environment is quite different from that of any other locality in our area and most of the plants mentioned above are found here only or at a very few other stations.

3. The association-types of streams and their flood plains.

A stream or river has, in a sense, a permanent association-type which is not a climatic climax-type. That is, as long as physiographic conditions remain constant, the stream and its vegetation, as well as the vegetation along its banks, will also remain relatively constant. Succession in the streams of Columbia County follows much the same course as that outlined for the lakes. A submersed-leaf type of association is followed by the floating-leaf type, which in turn is succeeded by the rooted-aquatic type, and so on. Such succession occurs only in backwaters or other stretches of quiet water, and is limited by the physical limits of the stream itself. Water currents and volumes tend to be about the same from year to year and so tend to keep the vegetation at about the same level. It sometimes happens that the stream is so situated that the currents are diverted by plant growths, and that its course is changed in this way, but this is usually only within narrow limits. Moreover, the stream is constantly wearing a new channel for itself through the erosive power of moving water, and plant-associations and individuals are thus assured of only temporary existence along a stream.

Extensive stretches of quiet water, where conditions are most favorable for the development of riparian communities, are found mostly in the Hudson and Harlem Valleys. The upper reaches of Kinderhook Creek and Roeliff Jansen Kill and their tributaries are shallow swift-running streams with long stretches over rocks or glacial pebbles, and support few well-developed plant communities. In the valleys, however, including those of Flat Brook and Stony

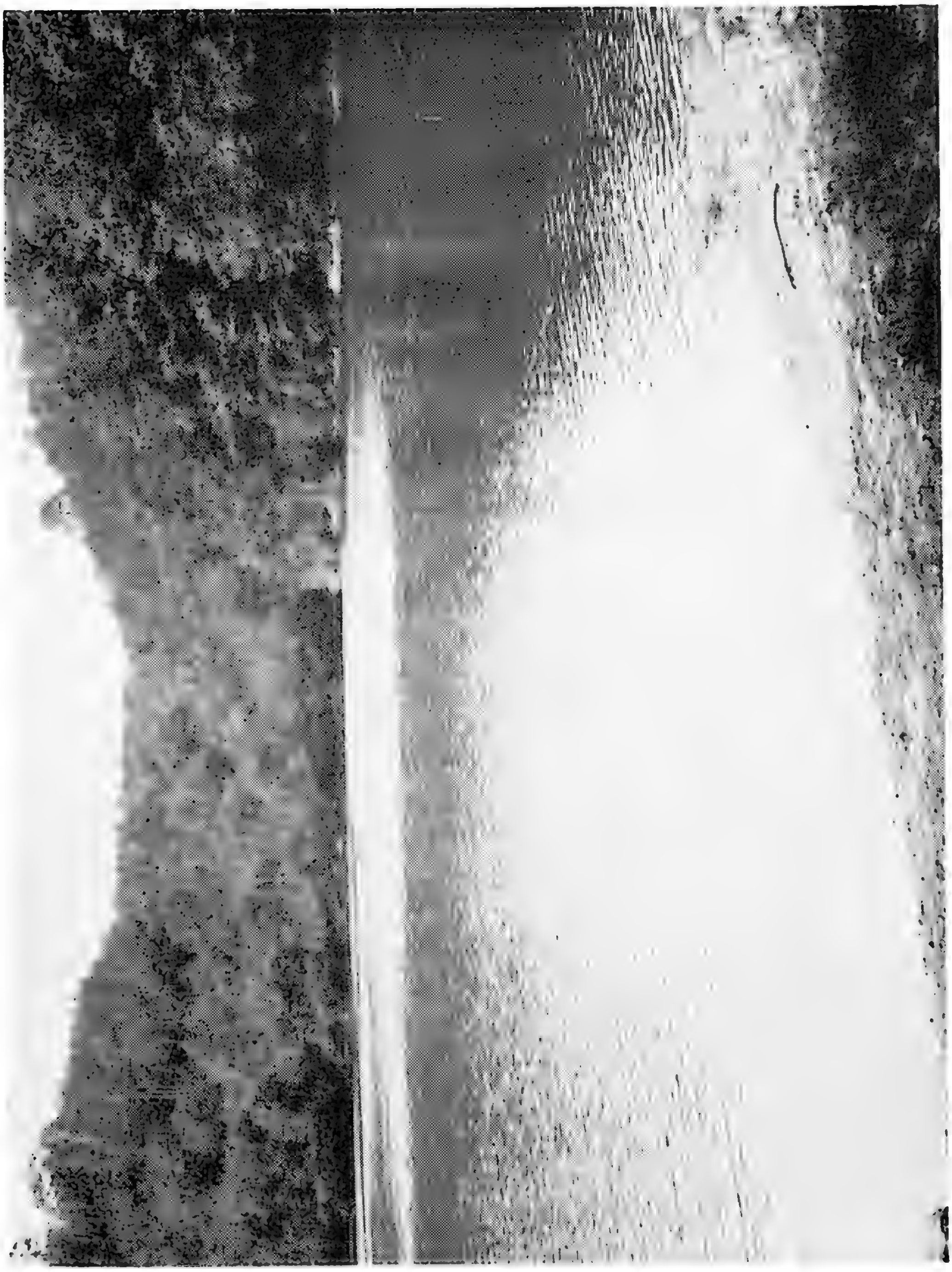

Figure 44. No Bottom Pond, Austerlitz. Limestone ledges may be seen along the shore at the right side of the picture.

Figure 45. Flat Brook, looking north from near Edwards Park Station. The grass in the foreground is *Phalaris arundinacea;* the common shrub along the brook is *Myrica Gale.*

Figure 46. Larch swamp at Miller Pond, Ancram.

Creek in the town of Canaan, as well as the lower valleys, a number of shallow still backwaters and coves have been developed.

The species found in the streams are fewer in number than those of the lake waters, and are, for the most part, widely distributed and common aquatics. The submersed association includes *Najas flexilis, Anacharis canadensis, Potamogeton epihydrus, P. amplifolius* and *P. foliosus*, with the first two by far the most abundant. Floating-leaved species include *P. nodosus* and sometimes water lilies.

In shallow water there may be a well-marked zone of rooted, emersed aquatics: *Typha latifolia, Sparganium americanum, Juncus effusus, Iris versicolor, Acorus Calamus, Pontederia cordata, Scirpus validus.* Where the soil is better drained but usually saturated or nearly so, the association of true aquatics is invaded by common grassy swamp species: *Phalaris arundinacea, Calamagrostis canadensis, Eleocharis calva, Carex lurida, Scirpus atrovirens, S. cyperinus* and *Dulichium arundinaceum.*

Following this zone of turf-forming plants, the succession usually passes directly to woodland or the seepage-swamp type, both of which will be discussed later. The last two stages mentioned above, the cattail stage and the grassy swamp stage, may be exactly duplicated at most of the lakes in the area, but usually only at restricted localities (see figure 45).

4. The association-types of seepage swamps.

Under this heading are included poorly drained areas of all kinds, except those previously described as lake swamps. Seepage swamps occupy a very considerable area in Columbia County, about 20,000 acres in all. Lewis and Kinsman (1929) include in the soils of Columbia County 3,520 acres of "muck" and 15,808 acres of "meadow," both of which belong, for the most part, to the seepage-swamp type. In addition, numerous small, poorly drained areas not shown on the soil map are here included in this association-type. The majority of swamps of this kind are located in broad flat stream valleys and are kept perpetually saturated by seepage or overflow from the streams themselves or by springs and seepages from the nearby higher ground. Although the largest swampy areas occur in the poorly drained lowlands of Copake, Ancram and Taghkanic, smaller ones are found along streams and in depressions in every town of the county, at all elevations up to nearly 2,000 feet (600 meters). The species concerned in the stages of succession differ somewhat under varying conditions, especially those of soil, and,

to a lesser extent, temperature. Accordingly they will be discussed under two headings:

a. In circum-neutral soils. Most of the large swamps along streams, as well as the widely distributed small swampy areas, are of the sort here described as characteristic of "circum-neutral" soils. Where poorly drained depressions occur, either in acid or neutral soils, the plant associations may be dominated by a group of aggressive herbaceous perennials, by a group of shrubs or by the swamp forest. Apparently these association-types represent stages in succession leading to a swamp forest similar to that described for the lake swamp (figure 41). The principal trees of such a forest are red maple and American elm, with the butternut, *Juglans cinerea,* the swamp hickory, *Carya cordiformis,* the swamp white oak, *Quercus bicolor,* and the black ash, *Fraxinus nigra,* playing subordinate roles. *Salix nigra* may be rather abundant but never attains a very large size, and the same is true of the ironwood, *Carpinus caroliniana.* The shrubby undergrowth may be made up of a number of species, including *Alnus serrulata* and *A. rugosa, Salix discolor* and *S. sericea, Cornus Amomum* and *C. stolonifera, Lindera Benzoin, Ilex verticillata, Solanum Dulcamara, Sambucus canadensis* and *Viburnum recognitum.* All of these shrubs, with the exception of *Lindera* and possibly of *Ilex,* are intolerant of shade to some extent, so that their numbers become successively fewer as the forest develops and *Lindera* comes to be by far the most abundant shrub in swamps and in swampy woods of all kinds. The herbaceous layer in the swamp is often dominated by ferns, including *Osmunda cinnamomea* and *O. regalis, Dryopteris cristata* and *D. spinulosa.* The skunk cabbage, *Symplocarpus foetidus,* is a conspicuous element in the Hudson and Harlem Valleys in areas of this kind but is not found northeastward. Other constant species of the forest floor are:

Onoclea sensibilis	*Rubus pubescens*
Cinna (arundinacea or *latifolia)*	*Amphicarpa bracteata*
Carex intumescens	*Impatiens capensis*
Arisaema triphyllum	*Viola blanda*
Habenaria psycodes	*Viola pallens*
Laportea canadensis	*Viola papilionacea*
Saxifraga pensylvanica	*Scutellaria lateriflora*
Rubus hispidus	*Scutellaria epilobiifolia*

In almost any swamp forest where there are mature trees it is possible to find relatively dry hummocks and areas of comparatively firm soil. Here are to be found *Betula lutea, B. populifolia, B. lenta* and *B. papyrifera.* White pine often gets a foothold, as does sugar maple. Herbaceous vegetation includes species of neutral or weakly

acid humus soils, e.g. *Lycopodium clavatum, L. lucidulum, L. complanatum* var. *flabelliforme, Maianthemum canadense, Trientalis borealis, Aralia nudicaulis* and *Mitchella repens,* all of which are to be thought of as upland species rather than those of swamps. The flora of such relatively well drained hummocks may be considered more highly developed than that of the surrounding, wetter swamp forest.

The various stages of succession leading up to the mature swamp forest as described above are thought to pass through an open meadow stage, dominated by herbaceous perennials, to a tall shrub stage. The tall shrubs, as enumerated just above (p. 298), are usually dominated by *Alnus rugosa* alone or with *Cornus Amomum* or *C. stolonifera* or both, and in slightly dryer localities by *Betula populifolia.* Willows include the pussy willow, *Salix discolor,* and the silky willow, *S. sericea. Viburnum recognitum* and *V. Lentago* are usually abundant, but always associated with other species. In the relatively open association of the tall shrub swamp, an important part is taken by two semi-herbaceous climbers, *Clematis virginiana* and *Solanum Dulcamara.* The undergrowth may be somewhat sparse and may include species found in the older swamp forest as well as in the open meadow stage.

The open meadow stage may usually be traced to a secondary origin; that is, it is usually possible to determine that the land has been cultivated or pastured within historical times. The same thing may be said, usually, of the tall shrub stage; these associations consist largely of species that are tolerant of various soil conditions and are easily distributed, either by wind or water currents, or by animals. The associations, therefore, arise fairly quickly; a tall shrub association of *Alnus rugosa* and *Cornus* may wipe out all traces of a *Carex-Scirpus* meadow in a decade.

In Columbia County the ill-drained areas that are allowed to lapse from cultivation or pasturage quickly become covered with "grass-like" plants, consisting mostly of the genera *Carex, Scirpus, Eleocharis* and *Juncus.* These common, semiweedy species include *Carex stipata, C. scoparia, C. granularis, C. stricta, C. crinita, C. comosa, C. lurida, C. lupulina, Scirpus atrovirens, S. cyperinus, Eleocharis obtusa* and *Juncus effusus.* Small areas not covered by the dominant species may support herbs like *Penthorum sedoides, Hypericum mutilum, Gratiola neglecta* and *Lindernia dubia.* The sedge meadow is soon invaded by a group of tall perennials:

Lilium canadense
Thalictrum polygamum
Spiraea latifolia
Spiraea tomentosa
Hypericum virginicum
Epilobium coloratum
Epilobium leptophyllum
Epilobium glandulosum

Angelica atropurpurea
Lysimachia terrestris
Lysimachia ciliata
Asclepias incarnata
Chelone glabra
Galium asprellum
Eupatorium perfoliatum
Eupatorium maculatum
Aster puniceus
Rudbeckia laciniata
Cirsium muticum

Such an association often includes some members of the tall shrub group and gives way directly to the latter stage. The two species of *Cornus* and two of *Viburnum* are most active in bringing about the change. On the other hand, if the sedge meadow is modified by grazing animals or by other means so that the broad-leaved herbaceous group cannot develop, the meadow is invaded mostly by *Alnus rugosa* or *Betula populifolia,* or both, rather than by the dogwoods or the viburnums. The birch and alder are weedy species and they seem to flourish equally well under a wide range of moisture conditions (see discussion below under old fields, p. 305) and may possibly not be included at all in succession under natural conditions.

b. In highly calcareous soils. In the Harlem Valley, in the towns of Hillsdale, Copake, Ancram and Pine Plains, there are extensive, nearly level, marshy areas where the soils are partly derived from the underlying limestone rocks. Smaller areas of similar types exist in Kinderhook, Ghent, Canaan and New Lebanon. The vegetation is very characteristic, comprising, besides many widespread and tolerant marsh-inhabiting plants, a number of well-known calciphilous species. Many of these are not found elsewhere in our area. The succession is of the same general sort as that described for poorly drained areas elsewhere; a sedge meadow stage is succeeded by a shrub stage and that by a swamp forest including red maple, American elm and black ash as the dominant species. The various species making up these association-types, however, are not the same as in the noncalcareous swamps described above.

Where the calcareous soil meadows are heavily pastured, only the wetter places support the characteristic vegetation. The most persistent species under such conditions are:

Eleocharis intermedia
Cyperus rivularis
Juncus brachycephalus
Parnassia glauca
Potentilla fruticosa
Gerardia paupercula
Lobelia Kalmii
Solidago Purshii
Bidens cernua

In larger areas of very wet soil, or where grazing is less severe, a mixed association of shrubs, herbs and "grasslike" species may flourish. Patches of *Phragmites communis, Phalaris arundinacea, Carex vesicaria* or *C. lacustris* often form large, nearly pure stands.

In the lowest wet areas *Selaginella apoda* and *Rhynchospora capillacea* may be found growing with most of the group of species named above (*Eleocharis intermedia* etc.), while tall herbs and shrubs usually play a considerable part in the sedge meadow association. In addition to ubiquitous swamp plants like *Cornus Amomum, C. stolonifera* and *Thalictrum polygamum* the most important species are:

Larix laricina
Muhlenbergia glomerata
Scirpus lineatus
Carex cryptolepis
Salix candida
Salix serissima
Betula pumila
Rumex orbiculatus
Ribes hirtellum
Geum rivale
Aronia arbutifolia
Rhamnus alnifolia
Conioselinum chinense
Galium labradoricum
Viburnum Opulus var. *americanum*
Valeriana sitchensis subsp. *uliginosa*
Cirsium muticum

In addition to the foregoing more or less calciphilous species, a considerable element of the flora of these swamps is made up of species found both in acid and calcareous bogs; in some cases acid conditions develop locally at the surface, due to accumulation of sphagnum or other causes, while the subsoil may be strongly calcareous (figure 17). A number of species come under this head and are locally abundant in the calcareous marshes:

Larix laricina
Eriophorum viridi-carinatum
Rhynchospora alba
Pogonia ophioglossoides
Sarracenia purpurea
Drosera rotundifolia
Hypericum virginicum
Menyanthes trifoliata

Succession to a swamp forest type may proceed in several ways from the sedge meadow-perennial herb association type. Elm and red maple may occupy the swamp fairly quickly, along with such taller shrubs as *Rhus Vernix, Viburnum Opulus* var. *americanum* and *Cornus* spp. This has happened or is in progress in the areas of this nature in Kinderhook, Ghent and the Canaan-New Lebanon region. In the Harlem Valley, however, notably at Croghan Hill and Miller Pond, in the town of Ancram, the tamarack, *Larix laricina,* and the dwarf birch, *Betula pumila,* together with *Rhus Vernix,* dominate good sized areas. At Miller Pond an estimated 2 hectares (5 acres) at the lower end of the pond is occupied by a larch-birch-sumac swamp of this type, which in places is almost impenetrable. The more open places support a sphagnum bog association, in which the conspicuous species are *Eriophorum viridi-carinatum, Iris versicolor, Sarracenia purpurea* and *Valeriana sit-*

chensis subsp. *uliginosa. Potentilla fruticosa* grows freely, often in very dense stands, to the exclusion of other vegetation (figure 46).

Throughout the calcareous marshes, *Potentilla fruticosa* is one of the most abundant species. It thrives equally well in pastures so that it frequently becomes a weedy species in the Harlem Valley on the more calcareous soils. In swampy places it is one of the first shrubs to appear in the meadows and it often grows so thickly as to form mats over which a man can walk. Other shrubs are much less abundant. *Salix candida* and *S. serissima, Ribes hirtellum* and *Rhamnus alnifolia* all occur as single individuals or in small patches.

Summary of the hydrarch successional series and their plant associations

Succession in all types discussed is thought to lead to a climax forest of the pine-hemlock-northern hardwood type. This climax is a climatic one, arrived at subsequent to the development of a deciduous swamp forest which is similar in lake, stream and seepage swamps. The intermediate stages in the development of the forest include tall shrub and sedge meadow stages, the latter being sometimes not recognizable. The various association-types differ as to species present, under differing physiographic conditions. In lake and stream successional series development may go through a bog stage or pass directly to forest conditions.

THE XERARCH SUCCESSIONAL SERIES AND THEIR PLANT ASSOCIATIONS

5. The association-types of glacial-till soils.

a. Where the soils are more or less acidic. The glacial-till soils occupy roughly one-half the entire Columbia County area. This includes 56,832 acres mapped by Lewis and Kinsman (1929) as being too rough and stony to support a definite soil type, but on which native plants thrive. The vegetation of the glacial-till soils is rather uniform with minor differences caused by conditions of soil and topography. The climatic climax is assumed to be one of the phases of the pine-hemlock-northern hardwood forest. On these acidic, glacial-till soils, however, or more properly in the part of our region occupied by these soils, the climax is seemingly more influenced by physiographic conditions than on any other soil type studied. Shallow rocky soils, somewhat acid in nature, in a generally hilly region with numerous rock outcrops, support a more xerophytic vegetation than is seen elsewhere, except locally. It is of course possible that these semi-xerophytic conditions have been brought about largely by

the clearing of the original forests; little or no evidence is available upon this point. Due to the prevailingly hilly and rocky nature of the terrain where soils of this type occur, it is natural to suppose that any succession would be slower than under conditions more favorable for plant growth. It does not seem probable, however, that any other climax forest than the pine-hemlock-hardwood would be the ultimate result of succession, except locally where physiographic conditions establish a more or less permanent climax other than the climatic one. The reasons for this are indicated below.

Throughout the following discussion much more than in any of the preceding, it must be constantly remembered that practically all the association-types studied are members of *secondary* successional series. While lakes, bogs, streams and swamps exist in relatively undisturbed conditions, upland plant communities have been greatly influenced by man. The original forest of our region has been almost entirely cleared, and the second-growth forests which we have available today for study exist for the most part *on the poorer soils,* in situations where, for reasons of one kind or another, agriculture does not pay. Except in rare instances we are not able to study native vegetation on ordinary, well drained upland soils, as these are largely under cultivation. Our ideas about succession on the glacial-till soils, then, must be obtained mostly from studies of "woodlots" and areas of shallow or rocky soil which are covered by woodlands. The forest which develops in situations of this type and is now prevalent in all of the hilly parts of Columbia County may be described as follows:

The dominant tree species are few in number with the chestnut oak, *Quercus Prinus,* and the red oak, *Q. borealis,* being represented by the largest numbers of individuals. The white oak, *Q. alba,* is also common, as is the pignut, *Carya glabra.* The chestnut, *Castanea dentata,* formerly played an important part in this forest but it is now almost gone, except for stump sprouts, due to the attack of the chestnut blight fungus. The paper birch, *Betula papyrifera,* is present in most of the woodlands, along with the black birch, *B. lenta,* and the sugar maple, *Acer saccharum.* In some localities, notably at the higher elevations, the paper birch is more abundant than any other tree. Other species which are usually conspicuous but seldom occur in great abundance are:

Pinus Strobus	*Fagus grandifolia*
Pinus rigida	*Prunus serotina*
Tsuga canadensis	*Acer rubrum*
Carya ovata	*Tilia americana*
Betula lutea	*Fraxinus americana*

In any mature forest of the above type there is an understory of smaller trees which grow freely in the shade of the larger ones. The most widespread and common of these is the hop hornbeam, *Ostrya virginiana.* Other small trees which are more common at the higher elevations but which grow throughout our range are *Acer pensylvanicum* and *A. spicatum,* both of which may be very abundant locally, and the shadbush, *Amelanchier arborea,* which occurs sparingly. *Cornus alternifolia* is also found sparingly throughout, while the flowering dogwood, *C. florida,* is very abundant as an understory forest species at elevations less than 300 meters, but is rare in the uplands.

The shrubby layer which flourishes in these woods is made up mostly of three species, the witchhazel, *Hamamelis virginiana,* arrowwood, *Viburnum acerifolium,* and pinkster, *Rhododendron nudiflorum.* Locally, under various conditions of light, moisture and soil acidity, the following may be abundant:

Corylus cornuta
Cornus rugosa
Vaccinium corymbosum
Vaccinium angustifolium
Vaccinium vacillans
Gaylussacia baccata
Diervilla Lonicera
Viburnum Rafinesquianum

The upper soil layers of the forest floor are usually somewhat acid (pH 5.0-6.5), so that the herbaceous plants of the forest are in part weak oxylophytes. Probably the most abundant and widespread species is *Aralia nudicaulis.* Other important members of the herbaceous layer are:

Pteridium latiusculum
Lycopodium complanatum var. *flabelliforme*
Lycopodium clavatum
Lycopodium obscurum
Carex pensylvanica
Carex platyphylla
Uvularia perfoliata
Smilacina racemosa
Maianthemum canadense
Hepatica americana
Polygala paucifolia
Sanicula marilandica
Pyrola rotundifolia
Pyrola elliptica
Chimaphila umbellata
Epigaea repens
Gaultheria procumbens
Lysimachia quadrifolia
Trientalis borealis
Hieracium paniculatum
Solidago caesia
Solidago bicolor
Aster divaricatus

A forest of the kind described above typifies the "dry rocky woods" which are mentioned in the accompanying annotated list. It is seen at its best development where the hills are not too steep, so that some soil is present everywhere, and where the rock outcrops are infrequent. In Columbia County these dry woods are found locally in the Hudson Valley, mostly in the vicinity of the Cossayuna soils. East of the Hudson Valley this woodland of chestnut oak,

red oak, birch and maple is practically coextensive with the Dutchess soils. Except where the underlying rocks are strongly calcareous or where they are covered by too little soil to support a forest, the most common association-type in our area is this "dry rocky woods" type.

It is not possible to do more than speculate about the original stages of development of such a forest. At present, when land of this kind is cleared and then abandoned, either at once or after a period of use, it is soon reoccupied by one or several of a group of weedy species. Recently cut forests may be overgrown rapidly by raspberries, *Rubus occidentalis* or *R. idaeus* var. *strigosus,* by pokeweed, *Phytolacca americana,* or by fireweed, *Erechtites hieracifolia;* lands which have been cleared and pastured and subsequently abandoned may be occupied by *Comptonia peregrina, Spiraea latifolia, S. tomentosa, Vaccinium angustifolium, Dennstaedtia punctilobula,* or by one or more of several species of small trees, namely: *Populus tremuloides, P. grandidentata, Betula populifolia, B. lenta, Alnus rugosa.* None of the above species, with the exception of the black birch, appears in the mature oak-birch-maple woodland and observations over a period of years lead me to the conclusion that all of the weedy pioneers of clearings and abandoned lands soon give way to the more stable forest.

While little can be said concerning the earlier stages of succession which lead up to the dry woodland type, there is some definite evidence which bears on the successional stages. My own observations indicate that certain species which are almost invariably present in these second-growth woodlands increase in importance with the age of the stand and eventually become the dominant species of the mature forest. Except in very recently cleared areas, a short search in any tract of "dry woodland" will usually reveal seedlings of *Tsuga, Acer saccharum, Pinus Strobus* and *Quercus borealis.* With the exception of the red oak, none of these assumes a commanding position in the dry woodland association. With increasing age of the forest, however, mesophytism becomes increasingly pronounced, especially in the herbaceous layer-societies, and the above species become of major importance. Most of the existing mature or nearly mature stands throughout the county show a heavy preponderance of white pine and hemlock as the dominant trees, with the accompanying sugar maple, red oak and lesser numbers of individuals of other species.

A mature hemlock-white pine forest which covers both hilly and swampy ground near the village of Lebanon Springs may be cited as an example. Although nearby second growth woodlands are dry

and relatively poor in plant growth, the forest itself is of a wholly different quality.

Nichols' (1935) list of the low shrubs and herbaceous plants characteristic of his "hemlock-white pine-northern hardwood" forest includes most of the species typical of this Lebanon Springs forest: "*Taxus canadensis, . . . Corylus rostrata, . . . Viburnum alnifolium, . . . Lonicera canadensis, . . . Sambucus racemosa, . . . Aspidium spinulosum, Lycopodium lucidulum, Lycopodium annotinum, Clintonia borealis, Smilacina racemosa, Maianthemum canadense, Streptopus roseus, Medeola virginiana, Trillium* spp. [in Columbia County, *T. erectum* and *T. undulatum*], *Actaea* spp., *Oxalis Acetosella, Viola* spp. [in Columbia County especially *V. rotundifolia*], *Aralia nudicaulis, Trientalis americana, Mitchella repens* and *Aster acuminatus.*"

A second case of the same kind is that of an island in Kinderhook Creek at Stuyvesant Falls. The island is very rocky, with a shale base and shallow soil, and stands 10 to 25 meters above the creek bed. The lower end of the island is covered by a dry oak woods, with trees not over a few centimeters in diameter. On the upper end of the island, however, in sandy or rocky unwatered soil, a mesophytic hemlock-beech-white pine forest has developed, with such accompanying species as *Taxus canadensis, Lonicera canadensis, Sambucus racemosa, Viola rotundifolia* and *Panax quinquefolius,* which are rarely found in the "dry woodland" type of forest. This island and its flora comprise probably the most important bit of evidence for the following assumptions: 1) that the climax on the rocky glacial-till soils is similar to the hemlock-pine-hardwood type discussed elsewhere, and 2) that the common oak-birch-maple woodland is a more or less temporary stage induced by man-made circumstances. Another point brought out strongly by the flora of the island at Stuyvesant Falls is that the absence of certain species from a region like the Hudson Valley may often be due to civilization and its works rather than to natural causes. This island has been protected from fire and from grazing animals, which may account, at least in part, for the presence of species considered rare elsewhere in the vicinity.

Finally, the Colebrook Forest, a virgin stand of some 300 acres which stood formerly in Litchfield County, Conn. (Nichols, 1913), seemingly developed under conditions nearly identical with those existing in the glacial-till areas of Columbia County. Litchfield County is adjacent to our area on the southeast, and the composition of this forest would seem to have considerable interest for the purpose of the present study. To quote from Nichols' account:

> As throughout most of Litchfield County the topography of the region concerned is very uneven and the elevations high. The forest was located partly in a rather broad valley, partly on the slopes of adjoining hills. The surface soil is of glacial origin, a sandy loam, often rocky, beneath which at varying depths is a substructure of precambrian gneiss which frequently outcrops at higher levels. . . . On the whole the soil is well drained.

This description fits closely that of much of the terrain occupied by glacial-till soils in Columbia County. The dominant trees of the Colebrook Forest were stated to have been approximately as follows:

Tsuga canadensis and *Fagus grandifolia*	55 %
Acer saccharum	12
Betula lutea	10
Quercus rubra (= *Q. borealis* var. *maxima*)	6
Castanea dentata	6
Fraxinus americana and *Tilia americana*	7
Prunus serotina, Betula lenta, Acer rubrum and *Pinus Strobus*	4

The underbrush of the Colebrook stand comprised, beside *Kalmia latifolia*, "*Viburnum alnifolium* and *Taxus canadensis* . . . in profusion," the latter "frequently . . . [preempting] considerable patches . . . in the lower grounds . . . to the exclusion of all other undergrowth." *Hamamelis virginiana, Viburnum acerifolium, Cornus alternifolia* and *Lonicera canadensis* were said to be "not infrequent," while *Sambucus racemosa* occurred "locally." *Acer pensylvanicum* and *A. spicatum* were also said to have been associated with these shrubs.

The herbaceous forest floor vegetation was also described by Nichols and a list of 54 species of vascular plants given, as well as lists of the more prevalent bryophytes. The list of vascular plants is here quoted in full, as all the species except one (*Habenaria macrophylla*) are represented in the more mesophytic and mature upland woods of Columbia County, although not always all together:

Polypodium vulgare
Phegopteris polypodioides
Asplenium acrostichoides
Asplenium Filix-foemina
Polystichum acrostichoides
Aspidium noveboracense
Aspidium spinulosum intermedium
Botrychium virginianum
Lycopodium lucidulum
Lycopodium obscurum
Brachyelytrum erectum
Festuca nutans
Carex Deweyana
Carex gracillima
Carex communis
Carex varia
Carex pennsylvanica
Carex laxiflora patulifolia
Carex arctata

Arisaema triphyllum
Clintonia borealis
Smilacina racemosa
Maianthemum canadense
Streptopus roseus
Medeola virginiana
Trillium undulatum
Cypripedium acaule
Habenaria macrophylla
Epipactis pubescens
Coptis trifolia
Actaea alba
Caulophyllum thalictroides
Tiarella cordifolia
Mitella diphylla
Dalibarda repens
Oxalis Acetosella
Viola rotundifolia
Circaea alpina
Aralia racemosa
Aralia nudicaulis
Osmorhiza Claytoni
Chimaphila umbellata
Pyrola chlorantha
Pyrola elliptica
Monotropa uniflora
Gaultheria procumbens
Trientalis americana
Epifagus virginiana
Mitchella repens
Solidago caesia
Aster divaricatus
Aster lateriflorus
Aster acuminatus
Prenanthes sp.

Nichols goes on to state that in second-growth woodlands near the virgin forest at Colebrook, "in localities which almost certainly once were occupied by forests similar to the one above depicted," the majority of the tracts were less mesophytic than the original forest. Oak, chestnut, hickory, white pine and paper birch became relatively more abundant in the second growth woodlands and hemlock less so. "The yew, hobble bush and moosewood are sparser and may have vanished completely, while *Prunus pennsylvanica, Gaylussacia baccata* and species of *Vaccinium* have made their appearance. Many of the herbaceous mesophytes also, like the twisted stalk, painted trillium and wood sorrel, have disappeared, being supplanted in a measure by such plants as *Lycopodium complanatum, Lycopodium clavatum, Dicksonia punctilobula,* and *Pteris aquilina,* forms rarely seen in the original forest." These observations check closely with those made in Columbia County. The second-growth woodland at Colebrook is very similar to the "dry rocky woods" of Columbia County.

In summary, it appears that while the xerophytic character of these rocky hilly woods may persist for some years, the hemlock-pine-hardwood forest eventually comes into its own, supplanting the oak-hickory type as the climax vegetation.

b. Where the underlying rock is calcareous. These plant communities differ little from those of acid soils except in the following ways: chestnut oak is rare or absent in the oak-maple-birch association; there is an increased abundance of *Tilia americana, Ostrya virginiana* and *Juniperus virginiana;* white oak and sugar maple are usually the dominant large-tree species and the undergrowth is

marked by the presence of a number of mesophytic species not often found in the woodlands discussed in the preceding section.

Limestones are widely distributed throughout the region, exposed either as small strata among the shales, as is the case in the gorges along the river in the town of Stuyvesant, or as thicker strata, often making up whole ridges or hills, but usually closely associated with shale or schistose rocks. In the Hudson Valley the limestones occur mostly along the north-south ridges characteristically connected with the Cossayuna soil series. The shale ridges are much more frequent than the limestone ones, but the latter may be traced from the exposures east of North Chatham and Kinderhook southward through similar exposures in Stuyvesant and Ghent to calcareous outcrops in Greenport and Clermont (see map, figure 23). Near the eastern edge of the Hudson Valley another belt of limestone may be traced from Tackawasick Lake and Brainard southward to Pulvers Station in the town of Ghent (Bishop, 1886, 1890; Ruedemann, 1930, p. 116). A third north-south belt of limestone, intersected by ridges and islands of schist, extends from Lebanon Springs southward along the western side of the Taconics to the lower Harlem Valley; the limestones at Canaan, Queechy Lake, No Bottom Pond, Hillsdale, Copake (Tom Hill) and Ancramdale (Croghan Hill) are all of this belt, which was considered by Dana (1887) to be continuous with that of Stockbridge and other points east of the Taconics. He considered the mountain masses of Greylock and Mount Washington to be great synclines, with continuous underlying limestone.

Unrelated to the foregoing rocks are the Devonian limestones exposed at Becraft Mountain near Hudson and at a small knoblike hill ("Mount Ida") north of Claverack. These two localities present essentially the same aspect, both being raised above the general level of the valley and partly surrounded by perpendicular cliffs from 3 to 15 meters high. Becraft Mountain is over 3 km. long by more than 1.5 km. wide, with the long axis nearly north-south and with cliffs extending along most of the west side. The cliffs are developed to a lesser extent along the eastern side, where Claverack Creek runs near the base of the hill. Where the slopes are steep enough for cliff formation, talus is conspicuous; along the west side the talus slopes may reach a height of nearly 30 meters. The top of the "mountain" is generally level or slightly rolling; it has been farmed but is now mostly abandoned. Much of the land is owned by a cement company, as the limestone is of excellent quality for the manufacture of cement and is being quarried rapidly for that purpose.

The outlier to the north of Claverack resembles Becraft Mountain in every respect except for its much smaller size. Both are highly

dependent upon precipitation for their water supply, as their elevated nature and the position of their strata has reduced ground water to a minimum and they become exceedingly dry in seasons of low rainfall.

Although no extensive woodlands occur on either of these limestone knobs, both are partially forested. As mentioned above, the dry woodland type of forest is predominant, but is marked by the rarity or absence of chestnut oak and by the unusual abundance of basswood, juniper and hop-hornbean. White pine and hemlock are found throughout, and there is at least one semi-mesophytic woodland on Becraft Mountain where the *Tsuga-Pinus Strobus* association occupies a whole ravine, with the undergrowth including such species as *Asarum canadense, Trillium erectum, Sanguinaria canadensis, Dirca palustris* and *Acer pensylvanicum,* all of which indicate the mesophytic character of the habitat.

For the most part the limestone ridges and outcrops of Columbia County are forested, except for the cliffs and other soilless areas. A good example of such a forest may be seen about 1 mile northeast of Hillsdale on an isolated hill about 45 meters in height. The slopes are steep but soil-covered, with only a few small exposed areas. The dominant trees are *Acer saccharum, Fraxinus americana, Tilia americana* and *Betula papyrifera,* which are abundant in approximately the order given. *Ostrya* and *Cornus florida* are abundant in the lower tree layer. The following are all present in some quantity:

Tsuga canadensis
Pinus Strobus
Carya ovata
Quercus borealis var. *maxima*
Quercus alba
Prunus serotina

Herbaceous vegetation is rich, including the following species:

Botrychium virginianum
Asplenium platyneuron
Festuca obtusa
Hystrix patula
Uvularia perfoliata
Smilacina racemosa
Polygonatum pubescens
Cypripedium Calceolus
Asarum canadense
Paronychia canadensis
Actaea alba
Aquilegia canadensis
Hepatica americana
Anemonella thalictroides
Thalictrum dioicum
Sanguinaria canadensis
Geranium maculatum
Aralia nudicaulis
Sanicula marilandica
Osmorhiza longistylis
Asclepias quadrifolia
Galium circaezans
Solidago caesia
Aster divaricatus
Senecio obovatus

Examination of the above list brings out some interesting points. Some of the species are practically confined, in our area, to habitats of this kind; that is, well drained calcareous rocky woodlands. *Asclepias quadrifolia* and *Senecio obovatus* are of this group. A number of other species are found in nearly all well drained woodlands where drought is never excessive and shade is not too great: *Uvularia perfoliata, Thalictrum dioicum, Paronychia canadensis, Sanicula marilandica, Aralia nudiculis, Polygonatum pubescens* and *Aster divaricatus.* Still a third group of species, characteristic of mesophytic habitats, indicates that even in comparatively youthful woods, where exposure is relatively great, a degree of mesophytism may soon be induced where the soil is relatively fertile:

Botrychium virginianum
Asplenium platyneuron
Festuca obtusa
Cypripedium Calceolus
Asarum canadense
Actaea alba
Anemonella thalictroides
Sanguinaria canadensis
Geranium maculatum
Osmorhiza longistylis

A second example of such a forest, where slightly more mesophytic conditions prevail, occupies the lower slopes of the hillside near Flat Brook, just south of the Edwards Park Station in the town of Canaan. The ground is gently sloping, actual rock outcrops are few, and boulder and talus slope vegetation is not in evidence. The forest developed here is notable for the large number of shade- and moisture-loving plants, many of which are particularly known as plants of calcareous regions:

Cystopteris bulbifera
Polystichum acrostichoides
Dryopteris marginalis
Dryopteris Goldiana
Camptosorus rhizophyllus
Athyrium angustum
Athyrium thelypteroides
Adiantum pedatum
Festuca obtusa
Oryzopsis racemosa
Arisaema triphyllum
Asarum canadense
Actaea alba
Hepatica acutiloba
Sanguinaria canadensis
Caulophyllum thalictroides
Tiarella cordifolia
Geranium Robertianum
Viola canadensis
Panax quinquefolius
Hydrophyllum virginianum
Triosteum perfoliatum
Solidago flexicaulis

6. The association-types of water-laid soils.

a. Sandy soils. The upland sandy soils of Columbia County, including some gravelly soils like the Otisville gravelly loam, occupy roughly 10 percent of the area of the county, this mostly in the Hudson Valley. Since the areas occupied by these soils are generally level or only slightly hilly, most of them are under cultivation. The

few remaining uncleared spots are in the form of woodlots in hilly situations. The soil reaction is in general acid. The soils are deeper than the rocky types previously discussed and the vegetation is somewhat less xerophytic. It is probable that the climax is regained more quickly after clearing on some of the sandy sites than on many of the rocky hills and ridges.

Forests 50 to 100 years old are found on this kind of soil at several localities, notably on two gravelly hills near the State Farm in the town of Kinderhook, along Valatie Creek just south of Niverville, along the south shore of Kinderhook Creek about 1.5 km. above Valatie and in a tract about 3 km. south of Claverack.

The most abundant larger trees, the "dominants," are *Pinus Strobus, Quercus alba, Q. borealis* var. *maxima, Acer saccharum* and locally *Tsuga canadensis* and *Fagus grandifolia. Acer rubrum, Pinus rigida* and *Carya glabra* are very abundant on the sandy soils. *Betula lenta* and *B. lutea* are very abundant locally. The following are usually present but rarely in any considerable numbers:

Carpinus caroliniana	*Amelanchier arborea*
Ostrya virginiana	*Cornus florida*
Prunus serotina	*Fraxinus americana*

Under the trees, *Viburnum acerifolium* and *Hamamelis virginiana* are always present, while the herbaceous undergrowth is fairly dense, including the following species:

Hepatica americana	*Lysimachia quadrifolia*
Anemonella thalictroides	*Collinsonia canadensis*
Desmodium nudiflorum	*Phryma Leptostachya*
Desmodium glutinosum	*Galium circaezans*
Circaea quadrisulcata	*Eupatorium rugosum*
Sanicula marilandica	

Less abundant are some of the species spoken of above as "dry rocky woods" species: *Chimaphila umbellata, Pyrola elliptica, Lycopodium complanatum* var. *flabelliforme, Trientalis borealis, Polygala paucifolia* and *Maianthemum canadense.* These occur locally, however, as do *Pteridium, Vaccinium* and *Gaylussacia.* The sandy-soil forests of the Hudson Valley are thus apparently somewhat more mesophytic than forests of similar age occurring eastward on the more rocky soils.

b. Clay soils. Water-laid clay soils occupy about 8 percent of the area studied, practically all situated in the Hudson Valley in the region immediately adjoining the river. These soils, which are for the most part referred to the Hudson soil series, have a small amount of lime present and, where drainage is sufficient, make good farm land. Their structure makes them relatively impervious to water,

Figure 47.
Figures 47, 48, 49. Mature forest about 1 mile northeast of Stuyvesant. Note the density of the stand and the presence of standing dead trees. Young plants of sugar maple appear in the foreground of figures 47 and 48.

Figure 48. For explanation see figure 47.

Figure 49. For explanation see figure 47

so that drainage is never excessive. The combination of fairly rich soil with a fine texture and no lack of water apparently has prevented the development of any sort of xerophytic forest-type on these soils. The uplands are nearly all cultivated, but along the Hudson River where the sloping banks are too steep for this, small streams have cut valleys through the clay loam. Here conditions for native plant growth have been ideal and rich mesophytic woodlands have resulted at many localities. These may stretch back from the river for more than a kilometer, as at Nutten Hook where a stream has cut a broad flat valley nearly half way back to Stuyvesant Falls, or they may occupy steep slopes that reach hardly a quarter of a mile (400 meters) back from the Hudson before they meet the cultivated land at the top of the inner valley of the river. The principal woodland areas of this kind are near Poelsburg, east of Nutten Hook, in the vicinity of Columbiaville and about the mouth of the Roeliff Jansen Kill.

The old forests of this sort may be typified by one about a mile south of Columbiaville where the distance from river to the top of the hill is over half a mile, or by those just south of Poelsburg where the slopes are steeper, becoming gorgelike in some places. The most abundant trees are *Tsuga canadensis* and *Acer saccharum,* with the former often growing in pure stands on the steepest slopes. Beech, *Fagus grandifolia,* is present but usully not at all abundant. *Quercus alba* and *Q. borealis* var. *maxima* are common except on the steepest banks, and *Fraxinus americana* is present nearly throughout. The birches are not conspicuous in this forest, although *Betula lenta* is usually present and *B. lutea* and *B. papyrifera* occasionally so. White pine may be present also, but fails to form a large element of the forest except near the upper margins of the woodland, where abandoned land is often taken over quickly by white pine and juniper, *Juniperus virginiana.* Along some of the narrower stream valleys in this area may be found also an association formed mainly of white pine, red oak, white oak and hickory (*Carya glabra* and scattered trees of *C. ovata*). Hemlock and maple are usually present in considerable number, at least as seedlings, in the oak-pine-hickory woods.

In 1933 there was standing in the town of Stuyvesant, in the valley of Mill Creek about 1 mile (1.6 km.) northeast of Stuyvesant Landing, a remnant of an old forest which was apparently a highly developed phase of the sort just described. It occupied about three-fourths an acre in a ravine cut into the Hudson silty clay loam. The trees grew thickly spaced, with numerous fallen logs but very little undergrowth; the latter included *Hamamelis virginiana* and

scattering plants of *Sambucus canadensis* in the more open places. Trees less than 6 inches (15 cm.) in diameter, breast high, were mostly hemlock, with a few black birch (*B. lenta*) and dogwood (*Cornus florida*). On the sides of the east-west valley were 154 standing trees of more than 6 inches d. b. h. (table 20).

TABLE 20

Composition of a mature forest in town of Stuyvesant

SPECIES	NUMBER OF TREES	SIZE (D. B. H.) INCHES 12	20	24	MAX.
Tsuga canadensis	51	10	2	2	27
Quercus alba	27	24	7	4	36
Pinus Strobus	26	25	14	7	32
Acer saccharum	13	9	3	1	25
Acer rubrum	10	3	1	0	22
Betula lenta	8	3	0	0	16
Carya sp.	7	5	0	0	16
Fraxinus americana	4	0	0	0	11
Quercus borealis var. *maxima*	3	2	0	0	16
Ulmus americana	2	2	2	0	23
Pinus rigida	2	2	1	0	20
Pinus resinosa	1	1	0	0	18

The ages of the larger trees, as determined by means of an increment borer, ranged from 125 to about 200 years. The oldest tree was the largest white pine, which showed nearly 200 annual rings. No evidences of lumbering could be detected in this tract, so it apparently had not been cut over for about 200 years (figures 47 to 49).

In most of the woodlands of the moist clay slopes near the river, the shrubby undergrowth is scant, as mentioned in preceding paragraphs. *Cornus florida* is fairly frequent, usually occurring as single trees, while *Ostrya virginiana* is present but not at all common. *Carpinus caroliniana* appears in the lower slopes of the broad valleys, as does the larger *Ulmus americana* and more rarely *U. rubra*. *Hamamelis virginiana* and *Viburnum acerifolium* make up a great part of the shrub society, and the leatherwood, *Dirca palustris*, is often found in considerable numbers. It is in the herbaceous growth of the forest floor, however, that mesophytism of this type of woodland is most easily recognized. In these woods, the "rich woodland" type of vegetation is more highly developed than anywhere else in the Columbia County area. The spring flowering species, especially, appear in great profusion:

Arisaema triphyllum
Erythronium americanum
Uvularia grandiflora
Uvularia perfoliata
Uvularia sessilifolia
Trillium erectum
Asarum canadense
Anemone quinquefolia
Hepatica americana
Anemonella thalictroides
Ranunculus hispidus
Thalictrum dioicum
Sanguinaria canadensis
Podophyllum peltatum
Dentaria diphylla
Dentaria laciniata
Geranium maculatum
Viola pensylvanica
Viola palmata
Viola pubescens
Galium obtusum

Summer- and fall-flowering species are also commonly represented, so the ground cover is always rather dense. The principal species of these latter seasons are:

Botrychium virginianum
Polystichum acrostichoides
Dryopteris marginalis
Adiantum pedatum
Brachyelytum erectum
Carex blanda
Carex platyphylla
Allium tricoccum
Medeola virginiana
Polygonatum pubescens
Corallorhiza maculata
Pilea pumila
Polygonum virginianum
Actaea rubra
Actaea alba
Desmodium nudiflorum
Desmodium glutinosum
Circaea quadrisulcata
Aralia racemosa
Sanicula canadensis
Sanicula marilandica
Osmorhiza Claytoni
Cryptotaenia canadensis
Monotropa uniflora
Collinsonia canadensis
Phryma Leptostachya
Prenanthes alba
Prenanthes trifoliolata
Eupatorium purpureum
Eupatorium rugosum
Solidago arguta
Aster divaricatus
Aster Schreberi

7. The association-types of rock outcrops.

Rock outcrops of various kinds are of frequent occurrence in Columbia County, being found in every town and associated with most of the soil types except some of the first bottom soils and some of the postglacial water-laid soils. Extensive exposures of rock are least frequent in the Hudson Valley, although ridges and small cliffs of both shale and limestone are to be found throughout, mostly associated with the Cossayuna soil series. East of the Hudson Valley, where the metamorphic rocks predominate, surface exposures of both acidic and calcareous rocks are very frequent. The largest exposures are found on the Taconic Mountains from Mount Fray southward and southeastward. The tops of these mountains form a nearly continuous exposed and dissected rocky ridge for more than 15 km. Slope, exposure, smoothness of surface and hard-

ness of rock vary greatly in the different outcrops. All these factors influence the character of the vegetation.

a. Where the rocks are calcareous (limestones). Succession in limestone regions seems to have been initiated by a few crevice plants, particularly the ferns *Pellaea atropurpurea* and *Asplenium Ruta-muraria;* by little annuals or biennials like *Arabis hirsuta,* which find lodging on ledges; by a few hardy shrubs like *Ribes Cynosbati,* and by a number of mosses and lichens. On the steep rock faces scarcely any other plants can grow. Where the rocks are less steep (including spots at the tops of cliffs) or where the exposure to sun or wind is less intense, as in ravines or on north-facing slopes, other crevice and rock-surface plants appear, including the following:

Cystopteris bulbifera	*Arabis canadensis*
Cystopteris fragilis	*Saxifraga virginiensis*
Camptosorus rhizophyllus	*Mitella diphylla*
Asplenium Trichomanes	*Rhus Toxicodendron*
Polypodium virginianum	*Celastrus scandens*
Carex eburnea	*Cornus rugosa*
Aquilegia canadensis	*Viburnum Rafinesquianum*
Thalictrum dioicum	*Solidago caesia*
Clematis verticillaris	*Aster cordifolius*

Along exposed limestone ridges the prevailing woody plants are often the shrubby dogwood, *Cornus rugosa,* the little viburnum, *V. Rafinesquianum,* and poison ivy, *Rhus Toxicodendron,* while bittersweet, *Celastrus scandens,* is often abundant. An association of this kind, which will include most of the crevice and the ledge species of the above list, may be seen on and around the cliffs just south of Old Chatham and, to a lesser extent, on the several limestone hills in the Harlem Valley and on the ridges extending south from Kinderhook to West Ghent (see map, figure 23).

In our area there are no large level areas of exposed limestone, and only on the cliffs themselves does this stage of the successional series persist. Since practically all the known exposures form cliffs which are perpendicular or nearly so, this ledge and crevice association was probably more abundant formerly than now. At present, most of the calcareous rocks of the region are accompanied by talus slopes which are now higher than the vertical height of the cliffs themselves. The vegetation of these slopes will be discussed briefly below. To summarize the account of the vegetation of the limestone rock exposures the following outline may be presented:

1. Cliffs and steep slopes. A few hardy species occur here This association is limited in extent.

2. Ordinary woodlands. In our area this is mostly deciduous forest in which the transition to mesophytic conditions is apparently quicker than in similar forests in regions of acid soil.

3. Talus slopes. In our area they are mostly covered by mesophytic forest. They are associated with almost every cliff and their total area is greater than that of the latter.

b. Where the rocks are acidic (schists and quartzites). This is the prevailing type of substratum east of the Hudson Valley except for the limited calcareous areas referred to above. In this rugged country there are numerous ledge outcrops on hillsides, and small areas of acidic rocks may be found throughout. In addition, more extensive exposures occur on most of the higher, steeper hills. The largest of these has been referred to above (page 319). As practically all the hills too steep for cultivation are wooded, it follows that many of the bare rocks are surrounded by woodland conditions. This is true for all except a limited number of hills, the summits of which are bare or occupied by exceedingly sparse and scrubby vegetation. As the small rocky areas surrounded by woods have quite a different flora from those of exposed summits, the two will be considered separately.

The areas surrounded by woods generally appear quite sterile. The only fern which acts to any extent as a pioneer on the rock surface is *Polypodium virginianum,* which often forms dense and extensive mats. True "rock plants" are rare, although such species as *Dryopteris marginalis, Polystichum acrostichoides* and *Aralia nudicaulis* come in abundantly even on the steepest slopes if the soil is deep enough. *Tsuga canadensis* grows in the most unlikely crevices, as does *Kalmia latifolia.* Even in the most mesophytic ravines the only chance for the establishment of a permanent association on the rock surface seems to be through the agency of the mats of *Polypodium,* in which various shrubs become established.

Around the edges of the rocks a number of plants become established in the shallow soil. In the shallowest of soil several mosses are conspicuous, including species of *Dicranum* and *Leucobryum.* In the surrounding areas are found commonly the *Dryopteris, Polystichum* and *Aralia* mentioned above, as well as *Arabis lyrata, Cardamine parviflora, Saxifraga virginiensis, Oryzopsis racemosa, Woodsia obtusa,* and others, depending upon the degree of shade and moisture in the given locality.

The plants characteristic of bare rocky summits are considerably more varied. In the first place although the habitat is an exceedingly exposed one, with probable high evaporation and excessive drainage, considerable soil is formed in crevices on the level or

gently sloping summits, thus affording considerable areas for occupation by plants. Due to the highly xerophytic nature of the habitat and in part to the shallowness of the soil, ordinary mesophytes do not thrive on these rocky exposures. The association-type is thus made up of a small tree and low shrub community, including a number of semixerophytic perennials as well.

The principal rocky summits where this association-type may be seen are as follows: Ashley Hill, Chatham, at 240 to 270 meters elevation; Douglas Knob, at 450 to 510 meters; on the hills about 3 km. southwest of Hillsdale, at about 390 meters; at the "Pinnacle" rocks, about 3 km. southeast of Churchtown, at 240 to 270 meters; in an almost continuous area extending from Mount Fray in the town of Copake southward and eastward along the summits of the Taconics to northwestern Connecticut and eastern Dutchess County, at elevations ranging from 450 to 600 meters. The last area is peculiar in many respects, and will be discussed below in detail.

As one approaches the summit of any of the hills named above a gradual disappearance of many species present in the lowlands is evident. *Quercus alba,* which may be present in the dry woodlands of the lower slopes, is almost wholly lacking in the higher, rockier situations and is replaced by *Q. Prinus,* which may in places form an almost pure stand. White pine and hemlock likewise disappear on the exposed slopes, and in dry situations at the higher elevations no maple except *Acer rubrum* is found. The paper birch, on the other hand, often becomes increasingly abundant with the ascent. The most striking features of these summits, however, is the appearance of the scrub oak, *Quercus ilicifolia,* in large quantities, usually accompanied by the pitch pine, *Pinus rigida.* On the summit of Cedar Mountain, for example, much of the nearly level summit area is covered by a dense oak-pine scrub. On most of the high Taconics the growth of scrub oak in the frequent shallow ravines near the summits is so dense that most other vegetation is excluded and it is extremely difficult to force a way through the thickets. On and near all the summits, ericaceous shrubs are frequent, often mingled with the oaks or making up thickets of their own. The principal species are *Vaccinium angustifolium, Rhododendron nudiflorum* and *Gaylussacia baccata,* the former providing a considerable source of income for the local inhabitants during "huckleberry" season. Further down the slopes, where the scrub oak mingles with other species, one of its principal associates may be the mountain laurel, *Kalmia latifolia,* which, however, is not found on the most exposed places.

On the rocks, usually in partial shade of a community of pitch pine, chestnut oak and scrub oak, are found such plants as:

Selaginella rupestris	*Aronia melanocarpa*
Woodsia ilvensis	*Amelanchier laevis*
Agropyron subsecundum	*Prunus pensylvanica*
Hystrix patula	*Aralia nudicaulis*
Deschampsia flexuosa	*Epigaea repens*
Danthonia spicata	*Gaultheria procumbens*
Oryzopsis asperifolia	*Vaccinium stamineum*
Muhlenbergia glomerata	*Vaccinium vacillans*
Carex pensylvanica	*Lysimachia quadrifolia*
Uvularia sessilifolia	*Diervilla Lonicera*
Maianthemum canadense	*Campanula rotundifolia*
Cypripedium acaule	*Hieracium paniculatum*
Clematis verticillaris	*Aster acuminatus*
Corydalis sempervirens	*Helianthus divaricatus*

On the slopes, just below the summit, stunted paper birch, chestnut oak and pitch pine make up an association with fire cherry (*Prunus pensylvanica*), shadbush (*Amelanchier laevis*) and sometimes black birch and red maple. The ericaceous shrubs with *Diervilla, Aronia,* and often the dwarf cherry, *Prunus pumila,* form a sparse cover in the partial shade. The herbaceous vegetation is patchy, with some turf formation by *Danthonia, Deschampsia* and *Carex. Agropyron, Campanula* and *Woodsia* behave as crevice plants, sometimes in exposed places. *Helianthus* and *Muhlenbergia* are sometimes associated with them where there is some soil. *Corydalis sempervirens* is one of the most constant associates of the community, being found almost exclusively on bare rocks in shallow, lightly shaded soil, while *Selaginella rupestris* acts in much the same way but is less frequent.

On the summits of the high Taconics, the continuous exposures of hard gray schists extend from Mount Fray southward and southeastward for some miles, forming an area quite distinct in vegetational aspect from that of any other part of Columbia County. I am unable to explain the abrupt termination of this area at Mount Fray. North of this mountain the Taconics, including those of equal or greater heights, are all forest or grass covered to their very tops. Small rocky areas are, indeed, exposed as in all this part of the county, but the peculiar plant-association developed south and east of Mount Fray is wholly lacking, although physiographic and edaphic conditions seem essentially similar.

South of Mount Fray, and including that mountain, the woods near the summits of all the hills east of the Harlem Valley resemble those just described for other exposed summits. Above 450 meters, however, all the aborescent species disappear except in the numer-

ous shallow ravines which intersect the smooth surface of the mountain summits in all directions. These ravines are from a few to 30 meters deep and from 3 to several hundred meters across, and in them chestnut oak, red oak, white birch and red maple grow close to the summits of the hills, together with the omnipresent and tangled *Quercus ilicifolia* (figures 50 and 51). On the exposed rocks, however, these species find it difficult to survive; stunted paper birch, red maple and oak are sometimes seen in shallow crevices but they never become large.

Wherever a foothold is afforded by the tiniest crack, however, the rock surface is occupied by two semiwoody perennials. One of these is the the bearberry, *Arctostaphylos Uva-ursi;* the other is a cinquefoil, *Potentilla tridentata.* These carpet the rocks in great profusion in many localities. Other crevices are occupied by low shrubs of several kinds, so that only the smoothest rocks are devoid of vascular plants. Characteristic shrubs are:

Aronia melanocarpa
Amelanchier stolonifera
Prunus pumila
Vaccinium angustifolium
Gaylussacia baccata

Herbaceous vegetation is of a rather xerophytic sort, the principal species being *Danthonia spicata, Deschampsia flexuosa, Carex pensylvanica, Andropogon scoparius* and *Solidago puberula. Lilium philadelphicum* appears occasionally, and in the ravines *Cornus canadensis* and *Clintonia borealis* are found.

Actual succession on these rocks appears to be of two sorts. One, the succession initiated by crevice plants like *Potentilla tridentata,* probably leads to a firmly anchored shrub community. The other, brought about through the pioneering activities of mosses and lichens which are abundant on the smooth surfaces of the rocks themselves (figures 52 and 53), probably gives rise to the *Carex-Andropogon-Deschampsia* "grassland" communities which cover good sized areas here and there.

The ultimate fate of the now widespread *Arctostaphylos-Potentilla* association is in some doubt. In some places, as at Brace Mountain, it appears to be on the point of extermination by the "grassland" community composed mainly of *Carex pensylvanica, Andropogon scoparius, Deschampsia flexuosa* and *Danthonia spicata.* In Austerlitz and New Lebanon high altitude meadows of a similar sort are extensive above 570 meters, and some of them appear to be reverting to forest. Paper birch and white pine are taking over much of the upland meadow east of the village of Austerlitz. It is possible that all the bare rocky summits of the southern Taconics will even-

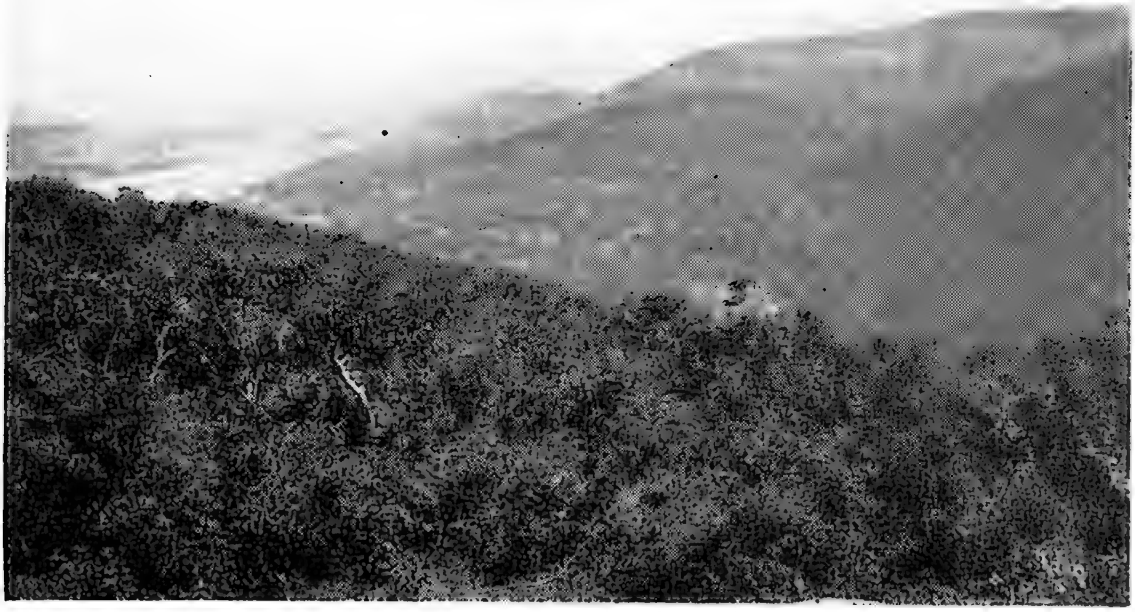

Figure 50. View across the valley of Bashbish Brook, looking north-northeast from Washburn Mountain. The hill in the foreground is covered principally by thickets of *Quercus ilicifolia*.

Figure 51. Mount Alander, looking east from a point about 3 km. south of Copake.

Figure 52. The village of Copake Falls as seen from Washburn Mountain; the village is about 200 meters below the point from which the picture was taken. Note the lichens growing on the otherwise bare rocks in the right foreground.

Figure 53. Vegetation near the summit of Washburn Mountain. Lichens nearly cover the rocks at the left and at the right are mats of bearberry, *Arctostaphylos Uva-ursi*.

Figure 54. Shale knoll about 1.5 km. south of Germantown. The shale here is harder than at some other points in our area and relatively little weathering is noted.

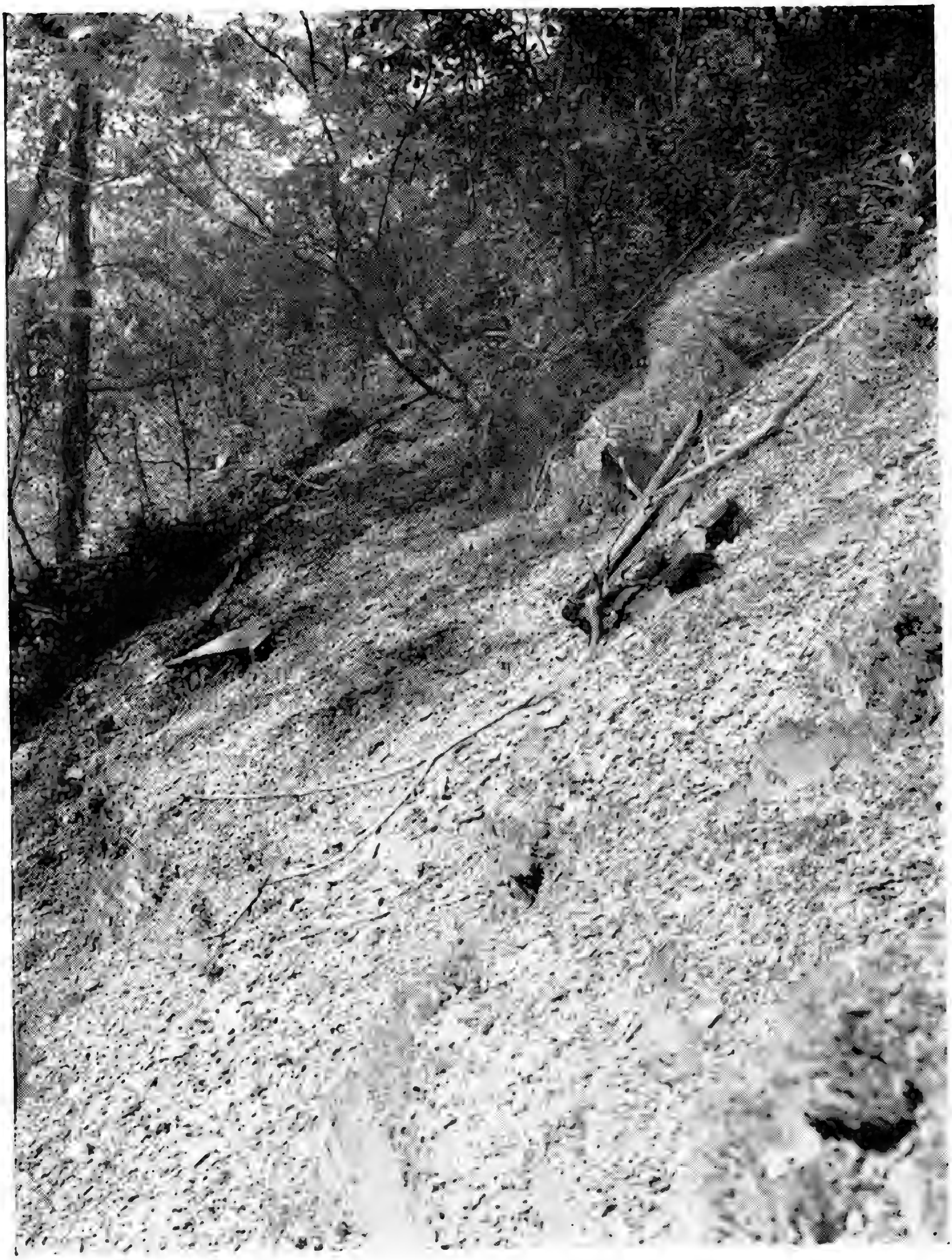

Figure 55. Shale slopes along the Hudson River north of Poelsburg. The shales here disintegrate easily and the slopes are unstable and covered by small fragments of weathered rock.

tually reach the climax indicated by climatic conditions; that is, a pine-hemlock-hardwood forest.

On the other hand, it is quite possible that the present low shrub association is a more or less permanent physiographic climax. Under natural conditions succession is apparently slow. There is no evidence that the communities of *Arctostaphylos-Potentilla-Aronia-Amelanchier-Prunus* have been disturbed within historic times. The first two in particular are known throughout their ranges as plants of exposed rocky summits, and it is highly improbable that either could have existed within the limits of any densely forested area. It is equally improbable that the association could have invaded the area *in toto* since the removal of the forest by the white man. In the absence of definite information as to the original covering of these rocky summits, then, it is probable that the present vegetation represents the highest stage of development that has been reached since the retreat of the glaciers.

c. Where the outcrops are shale. In the Hudson Valley shale is the prevailing type of substratum, and it outcrops frequently, forming exposed ridges and hills as well as actual bluffs. The steeper bluffs are found for the most part at or near the Hudson River, where they are represented on many of the islands and at several points on the mainland (figure 29); they may be accompanied by cliffs of considerable height. A second type of shale exposure is the kind well illustrated at Blue Hill, in the town of Livingston, where the slopes are steep and rocky without the formation of actual cliffs. Finally, associated throughout with the areas of the Cossayuna soils are numerous north-south ridges, varying in height from a few feet to several hundred feet, with the summits or sides exposed for short distances or covered with very shallow soil (figure 54). In all the shale outcrops there are certain similarities in physical conditions. The shale itself is relatively soft and disintegrates easily, forming crumbly, irregularly rounded exposures and but few vertical cliffs. Talus formation is extensive, but due to the crumbly nature of the shale the slopes are not composed of large blocks, as usual on limestone and quartzite or schist slopes; rather, the slopes are composed of small fragments which form an unstable, steeply sloping substratum (figure 55).

The areas surrounding the shale outcrops in Columbia County are for the most part forested, although many of the small exposures associated with the Cossayuna soils have been entirely cleared and are now in fields or pastures. The usual forest type is the "dry woods" described above as characteristic of many of the glacial soils in our region but with the addition of a considerable amount

of *Celtis occidentalis,* the hackberry. White pine, pitch pine and hemlock are usually present, along with an abundance of sugar maple, and the development of the climatic climax seems only a question of time. Usually a few shaly ledges in any given locality are not covered by woodland, and these ledges support an interesting association of plants which are not tolerant of shade to any extent.

The unstable nature of the shale makes uneven slopes and frequent crevices, and, as a result, the exposed surfaces are usually occupied chiefly by strongly rooted biennials or perennials, e.g.:

Woodsia obtusa	*Rhus aromatica*
Woodsia ilvensis	*Penstemon hirsutus*
Aquilegia canadensis	*Campanula rotundifolia*
Arabis lyrata	*Solidago squarrosa*
Saxifraga virginiensis	

On more or less level exposures, where shallow soil exists in small patches, three species are usually associated: *Cyperus filiculmis, Polygonum tenue* and *Selaginella rupestris.* These three occur also on the more stable places on the talus slopes in company with other species. This small association gives way in deeper soil to a more inclusive one dominated by *Andropogon scoparius* and other species, including *Panicum linearifolium, Carex pensylvanica* and the semi-weedy goldenrods, *Solidago nemoralis* and *S. juncea.* This association is often invaded by juniper (*Juniperus virginiana*), followed by white pine and other trees of the forest. Juniper is the usual pioneer species near the Hudson River, as may be seen at Mount Merino and Blue Hill, and is often accompanied by the hackberry. Farther inland, a far more common pioneer is the gray birch, *Betula populifolia.*

8. The association-types of talus slopes.

The vegetation of talus slopes is treated in a separate section rather than in connection with the accompanying rock outcrops since the vegetation of the slopes is generally much more mesophytic than that of the cliffs or bluffs from which they have been derived. This is true except in the case of the shales, where the rocks themselves in some cases are intermingled with interrupted slopes of disintegrated rock and the floras of the two also intermingle to some extent. The effects of soil conditions upon the character of the vegetation are often minimized by physiographic ones, so that talus from a limestone cliff may support much the same plant community as does that derived from an acidic rock. The similarity of vegetation in such cases seemingly is induced by the sheltered nature of the habitat, by good drainage, or by a combination of both.

a. Limestone talus. Slopes of this kind are found at Old Chatham, at Becraft Mountain and Mount Ida, at a locality just west of Douglas Knob in the town of Canaan and, to a lesser extent, at most of the other outcrops of limestone in our area. The limestone characteristically breaks up into definite blocks, so that the slopes are made up of irregularly shaped rocks of various sizes from large ones, several feet long, down to rough gravel. Almost any of these slopes shows a certain degree of mesophytism, even at exposed localities. The forest covering is similar to that described for calcareous regions in general and is doubtless a stage in the successional series toward a hemlock-pine-hardwood climax.

The understories of the vegetation differ but little from that of rich calcareous woodlands except for the increased abundance of certain shrubs. On the upper slopes, especially in moderate or light shade, *Cornus rugosa* is often the most abundant species and may grow in company with *Viburnum Rafinesquianum* and *Zanthoxylum americanum*. *Rhus Toxicodendron* is usually conspicuous in the same places, and climbs freely up the cliffs. Other trailing plants that may be locally abundant are *Menispermum canadense* and *Celastrus scandens.* Where there is deep shade in the forest, *Acer spicatum* is usually found in considerable amounts, as is its near relative, *Acer pensylvanicum.* The herbaceous ground cover is dense, being practically identical with that of the rich woods described above (page 310).

b. Talus in regions of acidic rocks (schist and quartzite). The only part of the Columbia County area where slopes of this kind occur to any extent is that along the eastern boundary of the Harlem Valley, where the relatively level valley is terminated abruptly by the nearly perpendicular slopes of some of the southern Taconics. Cliffs up to 15 meters or more in height occur locally at a number of points from Copake Falls south to Millerton, and at a few more northerly points as well, including a locality just east of the village of Green River. Less typical cliffs are at Curtis Mountain in Nassau, Ashley Hill in Chatham, and about a mile east of Pulvers Station in Ghent.

The most surprising thing about the vegetation of these localities is the resemblance it bears to that of the calcareous areas. The dominant forest trees are much the same except that chestnut oak is usually much more abundant on the less calcareous talus than on the limestone and *Cornus florida* and *Ostrya virginiana* are much less so. Locally, of course, depending upon the altitude, exposure and the age of the forest, one species assumes more importance than another. The smaller trees and shrubs seem to be nearly iden-

tical with those of the limestone talus slopes: *Acer pensylvanicum, A. spicatum, Cornus rugosa, Viburnum Rafinesquianum, Rhus Toxicodendron* and *Clematis verticillaris* are all abundant on schist and quartzite. Of the herbaceous species, the same holds true rather largely. A number of mesophytic species occur freely on the talus east of the Harlem Valley as well as at other points:

Cystopteris bulbifera
Cystopteris fragilis
Polystichum acrostichoides
Dryopteris marginalis
Asplenium Trichomanes
Athyrium thelypteroides
Adiantum pedatum
Festuca obtusa
Oryzopsis racemosa
Sanguinaria canadensis
Caulophyllum thalictroides
Panax quinquefolius
Solidago flexicaulis

The usual plants of moist, upland, acid soil woods, like *Viola rotundifolia, Clintonia borealis* and *Lycopodium lucidulum,* are rarely found in the vicinity of these talus slopes, so it appears that the latter deserve separate consideration as supporting an association-type distinct from that of other upland woods. With the accumulation of abundant organic matter, the soil reaction becomes progressively less acid; the pH value of the soil solution near the summit of the cliffs of the Taconics may be 5.0, but the soil of the talus slopes below the cliff, in a mesophytic forest-association, shows a reaction that is nearly neutral.

c. Talus where the substratum is shale. These slopes are rather unstable, often with excessive drainage, so that pioneer species are few and succession is relatively slow compared to that on the limestone talus. In a few localities, as at the Leake & Watts camp at Tivoli, at the north end of Crugers' Island and at a ridge about 2 miles south of Germantown, the loose shale slopes are forested and have a rich vegetation, similar to that of the ravines near the river (figures 59, 60). *Acer spicatum* and *A. pensylvanicum* are present and the rattleberry, *Staphylea trifolia,* is an abundant shrub. Common herbaceous plants are *Cystopteris fragilis, Laportea canadensis, Aralia racemosa, Dryopteris marginalis, Arabis canadensis, Carex platyphylla* and *Asplenium platyneuron,* all of which indicate a fair degree of mesophytism. Moist slopes of this kind are the exception rather than the rule, however. At the cliffs along the Hudson near the Columbia-Rensselaer county line (figure 55), at Blue Hill and Mount Merino, and at various inland points like the locality shown in figure 54, which is about 1.5 km. south of Germantown, the sliding shale slopes are dry, with relatively little vegetation. The forest, if any, consists principally of *Quercus Prinus* and *Carya glabra,* with considerable amounts of *Quercus borealis*

var. *maxima, Q. alba, Ostrya virginiana* and *Cornus florida. Pinus Strobus, Celtis occidentalis, Fraxinus americana* and *Juniperus virginiana* appear throughout. Due to frequent projecting shoulders of rock, much of the forest is rather open and considerable areas are wholly unshaded. Upon these are found characteristically the following:

Selaginella rupestris
Elymus canadensis
*Bouteloua curtipendula**
*Sorghastrum nutans**
Cyperus filiculmis
Quercus prinoides
Polygonum tenue
*Ranunculus fascicularis**
*Cassia nictitans**
Lespedeza virginica
*Polygala polygama**
Celastrus scandens
*Opuntia humifusa**
Aralia hispida
*Asclepias verticillata**
Isanthus brachiatus
Penstemon hirsutus
*Galium pilosum**
Solidago squarrosa
*Solidago rigida**

It is perhaps noteworthy that several of the above species, abundant at Blue Hill or at Mount Merino, or, in some cases, on neighboring hills, are rare elsewhere in Columbia County or are known from no other locality. Plants designated with an asterisk (*) in the above table belong to this group. A number of species common farther south and west, including *Celtis occidentalis* and many of the above herbaceous species, seem to be common in a rather restricted area in the southern part of Columbia County, especially on the shale slopes near the Hudson River.

9. The association-types of sand flats and gravel bars.

This type of habitat, while not extensive in Columbia County, is one of the most interesting to the student of succession, as it affords an opportunity to study the whole successional series, beginning with the earliest pioneers. The sand flats in this area extend along the Hudson River from Nutten Hook north to the head of tidewater. They were produced by dredging operations, begun in 1929, to deepen the main channel of the Hudson. The sand and silt which were dredged up were deposited at various points along the river, so that sand flats up to 400 meters wide extend, with some interruptions, from just north of Nutten Hook to just below Stuyvesant. Others were formed between Columbiaville and Hudson, on the west side of Hotaling and Schodack Islands and between Castleton and Rensselaer. The highest parts of the sand flats are 1 to 2 meters above high tide level. The most intensive studies have been made

on the area just north of Nutten Hook, and this area will be described as more or less typical of them all.[1]

The pioneer species are few, consisting principally of the following:

Eragrostis pectinacea
Triplasis purpurea
Digitaria sanguinalis
Cenchrus longispinus
Populus deltoides
Cycloloma atriplicifolium
Salsola Kali var. *tenuifolia*
Oenothera biennis
Xanthium orientale

The poplar, the only woody species that appears to be at all successful, thrives on the sand, but other trees seem unable to grow long enough in the dry upper layers to put roots down to the water table. Around the margins of the sandy areas, where the highest tides sometimes wash, several species of *Salix,* including *S. rigida, S. sericea* and the introduced *S. purpurea,* often grow in abundance. The dominant trees of the swamp forest of surrounding low areas along the river, *Acer rubrum* and *Ulmus americana,* seed in abundantly on the sandy areas, so that hundreds of young elm and maple seedlings may be seen in May and June. These seedlings rarely if ever become established, at least up to the present time.

Most of the pioneer species are weedy annuals and biennials which, although they cover the sand with fair completeness during the growing season (figures 14, 56, 57), contribute little toward a permanent ground cover. The high winds which sweep across the flats in winter blow away much of the dead leaves and stalks. *Cycloloma,* an easily blown tumbleweed (figure 14), and several other species are found nowhere else in the Columbia County area outside of these sandy and gravelly flats along the river, and doubtless they represent recent introductions to our flora, perhaps by way of stock cars on the New York Central Railroad or from other sources.

Where the sand is not so deep as that shown in the figures referred to above, and the water table is nearer the surface, a number of plants are found locally on the moist sands:

Panicum dichotomiflorum
Panicum virgatum
Cyperus odoratus
Cyperus inflexus

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[1] The account that follows was written in 1940. Rather striking changes took place on the sand flats in the succeeding 5 years, and discussion and photographs of the area have been published (McVaugh, 1947). When I visited the area in 1945 there was little evidence of invasion by native plants, but the poplars which had been 10 to 20 feet high in 1935 had grown into trees of considerable size and the weeds which had dominated the area (*Cycloloma, Triplasis, Eragrostis*) were no longer present in any abundance. For additional discussion of this, the reader is referred to the article cited above.

Cyperus strigosus
Scirpus americanus
Polygonum punctatum
Chenopodium ambrosioides
Mollugo verticillata
Strophostyles helvola
Acalypha rhomboidea
Sonchus arvensis
Aster simplex
Bidens bidentoides
Bidens connata
Helenium autumnale

An association of this kind usually becomes dominated by the more vigorous native plants. In wetter places, *Scirpus americanus* may form almost pure stands, while in slightly dryer situations a *Bidens-Helenium-Polygonum-Scirpus-Aster* community may arise. The latter is strongly reminiscent of some of the stages in the tidal-marsh successional series and it will doubtless be invaded in its turn by other species. The dry sandy areas, on the other hand, seem destined to be occupied, in the course of time, by a forest of *Populus deltoides*.

Under the general heading of sand flats may be discussed the gravel bars which occur along streams. These may be deposited in the form of islands in midstream or as marginal bars. The substratum varies from a fine sand to a coarse gravel, with various intermediate conditions. The principal bars of this kind occur along the largest streams, the Kinderhook Creek and the Roeliff Jansen Kill, but smaller ones may be found in almost any creek.

Sand and gravel bars are deposited by running water, and so lie at levels between high and low water. They are generally emersed during much of the growing season and support such vegetation as can find a foothold and maintain it during spring floods on the one extreme and summer droughts on the other.

The characteristic species of such habitats include a number of weedy plants: *Xanthium orientale, Polygonum Persicaria, Amaranthus retroflexus, Plantago major, Galinsoga ciliata, Echium vulgare* and others. Some of the species found there are hardly to be classed as weeds, but are widespread in similar situations: *Polanisia graveolens, Cyperus inflexus, Chenopodium Botrys, Juncus acuminatus* and *Melilotus officinalis.* A few woody species, including *Populus deltoides* and *Salix rigida,* usually become established in a few years, and *Platanus occidentalis* may do the same thing. If these species survive flood waters and the scraping of ice for a few years a permanent island or a high bank may be built up.

SUMMARY OF THE XERARCH SUCCESSIONAL SERIES AND THEIR PLANT-ASSOCIATIONS

Succession in all types discussed is thought to lead to a climax forest of the pine-hemlock-northern hardwood type wherever phys-

iographic conditions make this possible. Successional stages in this include the oak-hickory or oak-maple woodlands. The earlier stages of succession on the actual rock outcrops are thought to proceed very slowly and it is suggested that in certain cases a physiographic climax type may be reached instead of a climatic one.

THE MESARCH SUCCESSIONAL SERIES AND THEIR PLANT ASSOCIATIONS

10. The association-types of ravines and steep hillsides on the water-laid soils.

Woodlands approximating those of the slopes along the Hudson River may be found scattered throughout the Hudson Valley on most of the steep sandy, rocky or clay hillsides overlooking the larger streams. The dominant tree species are much the same as those previously discussed with *Tsuga* most abundant on the steeper slopes. The rich character of the herbaceous vegetation is very similar in both areas. Nowhere is this type of woodland so extensive as immediately along the river. Most of the smaller slopes have been pastured or cleared at some time, and they are seemingly somewhat less mesophytic than those of the inner river valley. Rich woodland slopes of this sort occur on sandy soils in the valley of the Kinderhook Creek at Kinderhook, on sand and gravel near Niverville, on gravels near West Ghent, on silt just south of Mount Merino in Greenport, and on sand east of Clermont in the valley of the Roeliff Jansen Kill.

11. The association-types of flood plains.

Under the term flood plains are included areas, both large and small, which make up the more or less level land along a stream, the soil of which has been derived in part from stream overflow. The soil is usually a fine loam, but may be gravelly or even stony, especially in the small flood plains developed in some of the creeks in hilly regions. The areas of "first-bottom" soils of this sort are mapped by Lewis and Kinsman (1929) as making up about 4.5 percent of the area of Columbia County, much of this being in the valley of Kinderhook Creek from West Lebanon to Stuyvesant Falls. Hundreds of similar areas too small to map exist throughout our area, so that at least 5 or 6 percent of the total acreage has been occupied at one time by flood-plain vegetation. Due to the fact that most such areas are nearly level, with good drainage and good soil, most of them are cultivated or used as meadow or pasture land. A

number of native and introduced species are generally present in considerable amounts in such meadows:

Festuca elatior
Poa pratensis
Poa palustris
Agrostis alba
Phleum pratense
Anthoxanthum odoratum
Carex vulpinoidea
Carex stipata
Carex scoparia
Carex cristatella
Carex granularis
Carex conoidea
Carex lanuginosa
Ranunculus acris
Lobelia spicata
Rudbeckia hirta
Chrysanthemum leucanthemum var. *pinnatifidum*

Where a level space along a creek is undisturbed for a few years there commonly develops an association-type similar to the mesophytic woodlands previously described. The pioneer woody plants are alders (usually *Alnus rugosa*), various species of willows (*Salix nigra,* the native aborescent willow, or one of several introduced species), *Betula populifolia, Platanus occidentalis* or, in some cases, the shrubby dogwoods or even red maple and elm. In addition to the pioneer woody species a number of herbs are usually found in such flood-plain meadows:

Carex hirtifolia
Luzula multiflora
Veratrum viride
Allium canadense
Erythronium americanum
Lilium canadense
Polygonatum canaliculatum
Sisyrinchium angustifolium
Sisyrinchium montanum
Anemone canadensis
Ranunculus septentrionalis
Thalictrum polygamum
Viola conspersa
Viola cucullata
Viola fimbriatula
Oenothera perennis
Zizia aurea
Pastinaca sativa
Lysimachia ciliata
Veronicastrum virginicum
Pedicularis canadensis
Eupatorium maculatum
Aster novae-angliae

Along the very banks of the stream, where drainage is apt to be better than farther back from it, a small but very select group of species often flourishes in company with some or most of the foregoing. These include:

Pteretis pensylvanica
Elymus riparius
Elymus Wiegandii (Hudson Valley only)
Elymus villosus (Hudson Valley only)
Elymus virginicus
Panicum clandestinum
Carex torta
Acer saccharinum (Hudson Valley only)
Echinocystis lobata
Sicyos angulatus
Ambrosia trifida (Hudson Valley only)

As the development of the vegetation of such a meadow progresses, such trees as sycamore, *Platanus occidentalis,* elm, *Ulmus americana,* red maple, *Acer rubrum,* or white ash, *Fraxinus americana,* come to be the dominant plants. The lower layers of the association come to resemble closely those of the mesophytic forests of the river slopes. This resemblance may be modified to some extent by the fact that some or all of the flood plain may be flooded periodically, but it is probable that in time a mesophytic forest will develop there, governed only by the course of the stream and the height of its water.

12. The association-types of rocky stream gorges.

There are in the Columbia County area a number of steep-sided rocky ravines, each having a stream flowing through it for at least a part of the year and each supporting a characteristic flora. The nature of the ravine is such that during the warm season the temperature is usually lower than that of the surrounding country, and the relative humidity is greater than that of nearby localities on the uplands. In consequence, a steep ravine furnishes a very mesophytic habitat for plants, and the vegetation is often of a somewhat more mesophytic nature than that of surrounding areas. The climax, however, in eastern North America or other moist regions is not a climatic one but is determined by the nature of the ravine itself. The climax is the most advanced type of vegetation that can find a foothold on the rocky ledges and walls.

In the region studied there are two quite distinct series of rocky ravines, which may be discussed separately:

a. The ravines along the Hudson River. As explained above (page 236), the river lies in a deep trough, the eastern wall of which consists in part of cliffs and in part of steep hillsides. To go from any of the villages or railroad stations which lie at river level back to any point a few miles inland, it is necessary to ascend a steep hill, the vertical ascent varying from 30 to 60 meters. At certain points the larger streams have worn broad valleys; the Kinderhook Creek, for example, falls to sea level at the river from about 210 meters at New Lebanon in a distance of about 35 miles (56 km.). It drops the last 60 meters in 10 miles over a series of falls, the principal ones being at Valatie, Stuyvesant Falls and Chittenden Falls. The last mile of its course is down a gradual slope (see also figure 58).

A number of small streams, on the other hand, some of which may be entirely or nearly dry in summer, run their entire course in a few miles and drop abruptly from the bluffs to the river. In at

Figure 59. Rocky gorge in the shales about 1 km. south of Poelsburg. The stream follows a winding course which may be followed nearly to the top of the hill by the small patches of white water.

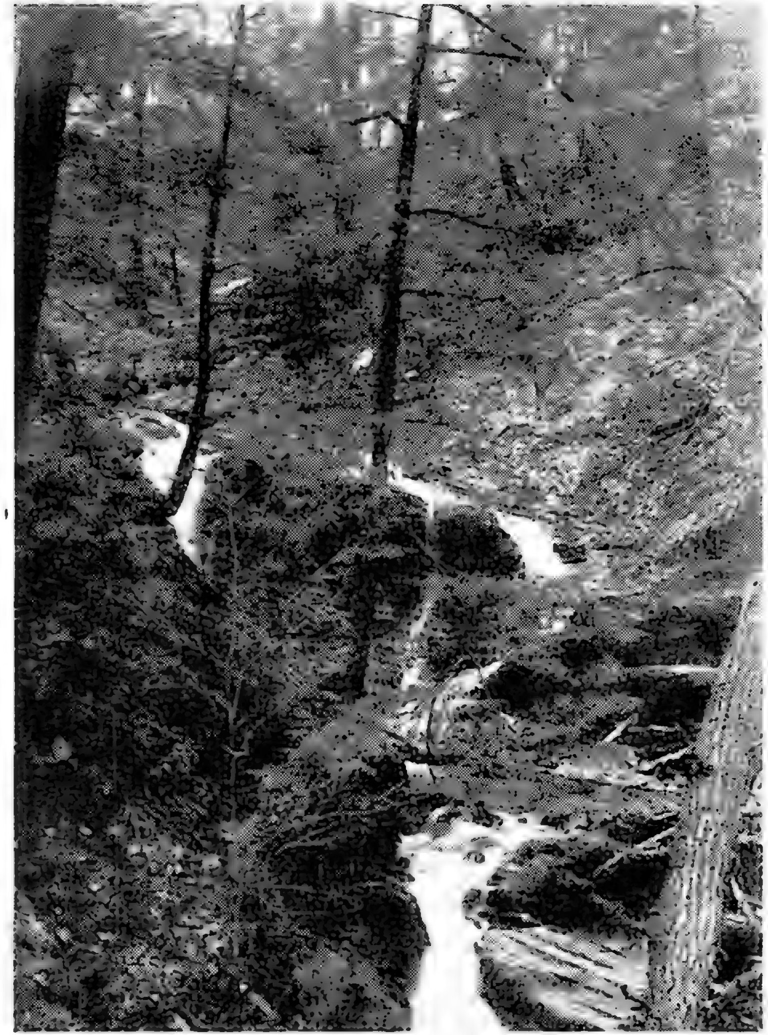

Figure 60. Lower end of the gorge shown in figure 59. The slopes on both sides are formed of small fragments of the rotten shales. A few hemlocks find a foothold in this precarious position.

Figure 61. The mouth of Bashbish Gorge, looking northeast from the summit of Washburn Mountain. The mountain at the right is Bashbish Mountain and that across the gorge is Cedar Mountain.

Figure 62. Bashbish Gorge as seen from just north of Copake Falls. The mountains rise abruptly from the lowlands of the Harlem Valley.

least one or two cases the entire drop of about 30 meters is made in a single series of cascades. The amount of water in these streams is so small that the only result of its erosive action to date is the production of narrow gorges cut into the rock underlying the clay soils. Several gorges of this type are found in the town of Stuyvesant, cut through the Cambrian shales, limestones and conglomerate. One such gorge occurs at the Columbia-Rensselaer county line and a second less than a mile south of Poelsburg (figure 59). Others occur in the somewhat younger shales in the towns to the southward; one lies just south of Columbiaville, in the midst of a rich woodland. Still others occur at Cheviot and in the northern part of the town of Germantown. At the extreme northern end of our region, about 3 miles north of Castleton, is another fine example.

The steep sides of such ravines and the nearby slopes are usually wooded. As is to be expected, the commonest type of forest is the mesophytic river-slope forest described above. The gorges are cut through these river slopes and are generally surrounded by woodlands. Most of the steep slopes support a dense growth of hemlock, which in some cases grows to a large size even in seemingly precarious positions (figure 60). The shales fragment rather easily, so that the rock is usually exposed in a highly irregular manner. The streams often descend in a series of short cascades. Except near the summit where *Polypodium virginianum* often forms dense mats, few plants grow on the exposed shales, probably because they are quite rotten and form a very unstable habitat. The little spleenwort, *Asplenium Trichomanes,* sometimes obtains a foothold, and where a stratum of limestone is exposed the cliff brake, *Pellaea atropurpurea,* may persist for a time.

Below the nearly perpendicular rocks there is usually a good deal of fine shale debris forming a talus slope which may be as much as 7.5 meters high (see right hand slope in figure 60; also figure 55 for a similar slope in a dry situation). This talus slope may be very steep and easily disturbed, so that it is nearly impossible to climb. On such a slope a number of plants find a place; among these are the hemlocks themselves, the leather-wood, *Dirca palustris,* two maples, *Acer pensylvanicum* and *A. spicatum,* wood nettle, *Laportea canadensis,* spikenard, *Aralia racemosa,* and some ferns, including *Dryopteris marginalis, Cystopteris fragilis* and *Asplenium Trichomanes.* In similar situations but on somewhat more stable footing occur the yew, *Taxus canadensis,* the fly honeysuckle, *Lonicera canadensis,* and ginseng, *Panax quinquefolius.* Both black and paper birch (*Betula lenta* and *B. papyrifera*) may occur in some quantities among the younger hemlocks on the steep slopes. The

particular interest attached to such a ravine lies in the fact that many of the plants which do well there are quite rare in the surrounding lowlands of the Hudson Valley and common only in the cooler woodlands farther east.

b. The ravines and gorges of the highlands east of the Hudson Valley. The rocks in this section are largely schist and quartzite. The average elevation above sea level is greater and the ravines are larger than in the Hudson Valley. Several of the ravines are occupied by permanent streams. The largest and most noted of these ravines is that occupied by Bashbish Brook. The ravine, which is nearly 2 miles long, is partly in the town of Mount Washington, Mass., and partly in Copake. The stream lies nearly 330 meters below the tops of the hills to the north and south (figures 61 and 62). A description of the gorge and stream is given by Hitchcock (1841).

Just east of the New York-Massachusetts state line is Bashbish Falls, where Bashbish Brook enters a steep-walled rock gorge and falls about 30 meters in a series of steep cascades and a final vertical drop. The walls of the gorge tower above the stream and support little vegetation, but the steep sides of the ravine both above and below the falls are heavily wooded (figure 61). The stream at this part of its course runs nearly due west and a striking contrast may be seen between the coverings of the north- and south-facing slopes. The lower part of the north-facing slope is covered by a highly mesophytic forest dominated by hemlock and yellow birch, with much *Acer pensylvanicum* and *A. spicatum* in the lower layers. The shrubby undergrowth, consisting mostly of *Taxus canadensis* but with considerable admixture of *Viburnum alnifolium, Lonicera canadensis* and *Sambucus racemosa,* is so thick that it is difficult to force a way through (see figure 4, p. 36). Herbaceous vegetation is abundant where it is not excluded by the dense growth of the yew, and consists principally of the following:

Dryopteris intermedia
Dryopteris marginalis
Clintonia borealis
Streptopus roseus
Mitella diphylla
Oxalis montana
Aralia racemosa

Mosses and lichens are abundant, especially on the frequent boulders and projecting rock shoulders. Much of the rock surface is covered, except in the steepest places, with mats of bryophytes, lichens and the fern *Polypodium virginianum.*

A line-transect cut directly southward from the stream just below Bashbish Falls, near the state line, to the top of Bashbish Mountain would show xerophytism of the vegetation increasing with altitude.

Figure 63. View down Bashbish Gorge, looking west from a point directly above the falls. The hills in the distance are on the west side of the Harlem Valley.

The yew, especially, thins out quickly, and is rarely found more than 60 meters above the stream. The hobblebush may be found in limited amounts nearly to the top, but the undergrowth as a whole is much less dense except near the summit, where *Kalmia latifolia* or *Quercus ilicifolia*, or both, form thickets that are 2 to 3 meters high and practically impenetrable. Except in these thickets, herbaceous vegetation is plentiful, with an abundance of the following species:

Maianthemum canadense
Aralia nudicaulis
Cornus canadensis
Epigaea repens
Lysimachia quadrifolia
Trientalis borealis
Melampyrum lineare
Aster acuminatus (perhaps the most abundant species)

On the upper, dryer slopes the paper birch, *Betula papyrifera,* largely replaces the hemlocks as the dominant tree. Locally, especially near the top of Bashbish Mountain, there is an association dominated by a group of species including paper birch, black birch (*B. lenta*), oaks (*Quercus borealis* and *Q. Prinus*), and red maple (*Acer rubrum*), with the undergrowth made up largely of various members of the Ericaceae, including *Kalmia, Vaccinium angustifolium* and *Gaylussacia baccata.* Open grassy clearings covered with a rather sparse growth of *Deschampsia flexuosa* are frequent and *Pteridium latiusculum* and *Lysimachia quadrifolia* are common. Figure 63 shows a view down Bashbish Gorge, looking west; the conspicuous trunks of the paper birch in the middle distance give some idea of its abundance on the upper slopes.

The south-facing slope of the ravine of Bashbish Brook, which is also the southern slope of Cedar Mountain, supports a very different group of plants from that just described. The whole side of Cedar Mountain, to within a few hundred feet of the top, is covered by a deciduous forest in which the principal part is played by oaks (*Quercus Prinus* with a smaller amount of *Q. borealis*). Some maple (*Acer saccharum, A. rubrum, A. pensylvanicum*) and birches (*Betula lenta, B. papyrifera, B. lutea*) are present, as well as some hickory (*Carya glabra*). The shrubby and herbaceous growth is essentially that of "dry rocky woods" in acid soils elsewhere in our area:

Danthonia spicata
Hamamelis virginiana
Aureolaria flava
Aureolaria virginica
Viburnum acerifolium
Aster laevis
Aster undulatus

At about 60 meters from the summit, the open forest gives way to small scrubby trees, principally *Quercus Prinus.* The terrain becomes increasingly rocky, with little or no soil over large areas. At the sum-

mit the chestnut oak is largely replaced by an association of *Quercus ilicifolia* and *Pinus rigida.*

The contrast between the two slopes of the gorge seems very great, both to the botanist and to the casual observer. The tangled undergrowth of the slope of Bashbish Mountain is strikingly different from the relatively dry open south slope of Cedar Mountain. The plant-associations of the two slopes are, as has been pointed out, very different in character, the differences evidently being due to the exposures, north and south respectively.

The ravine as a whole is of special interest, but particularly so on the lower slopes of Bashbish Mountain not only because of the relatively mature mesophytic plant association-type found there but also because of the presence of a number of plants not found on the surrounding mountain slopes nor in nearby woodlands, plants characteristic for the most part of more northern latitudes or of higher altitudes. Like conditions and like flora are found in our area only near the summit of Mount Everett and on the high hills adjacent to the Rensselaer Plateau. Examples of these species which are mostly rare elsewhere in Columbia County are: *Dryopteris disjuncta, Streptopus amplexifolius, Sagina procumbens* and *Oxalis montana.*

The ravine occupied by Bashbish Brook is more spectacular than any other similar ravine in our area because of its great size. Very similar conditions may be found, however, on a smaller scale along almost every stream that descends from the Taconic Mountains to the Hudson Valley. Steep ravines are cut out by the outlet of Berry Pond, in Hancock; by streams running off the west side of Perry Peak, in Canaan; by several brooks emptying into Green River near Austerlitz; by small tributaries of Bashbish Brook which have their sources on or near Mount Alander near the line between Ancram and Copake; and by numerous smaller watercourses. A description of one of these ravines is that of Bashbish Gorge in miniature: a rocky stream bed between steep walls of acidic schist and quartzite; the north-facing slope often dominated by hemlocks and the south-facing one by oaks, sugar maple and occasional birch; the hemlock forest relatively moist, supporting a rich vegetation of ferns and mesophytic herbs; the oak, maple and birch forest tending to be dry, with numerous hardy shrubs like *Vaccinium* and *Gaylussacia;* the lowest slopes of the ravine, near the stream, often supporting *Dryopteris Phegopteris, Gentiana clausa, Cystopteris fragilis, Laportea canadensis, Carex scabrata* and *Tiarella cordifolia.*

It is in ravines of this kind and on the adjoining, less steeply sloping areas that species of boreal affinities are most often found

in Columbia County. At altitudes of 300 meters or more, in the eastern highlands of this area, a number of plants are found which are rare in the Hudson Valley or entirely absent, but which are common a little farther north on the Rensselaer Plateau and still farther north in the Adirondacks:

Dryopteris disjuncta	*Corylus cornuta*
Dryopteris Phegopteris	*Claytonia caroliniana*
Taxus canadensis	*Stellaria calycantha*
Cinna latifolia	*Sagina procumbens*
Luzula carolinae	*Oxalis montana*
Lilium philadelphicum	*Viola rotundifolia*
Clintonia borealis	*Circaea alpina*
Streptopus amplexifolius	*Gentiana quinquefolia*
Streptopus roseus	*Viburnum alnifolium*
Trillium undulatum	*Sambucus racemosa*
Cypripedium acaule	*Aster acuminatus*

The appearance in these ravines of a number of "northern" species not found elsewhere in the immediate vicinity leads to speculation as to the reasons for their presence here. If, as has been suggested several times in the course of this study, the climax forest over all the region was similar to that described at Colebrook by Nichols (see above, page 306), it is then probable that many of these species were prominent in the virgin forest (compare description of Bashbish gorge, p. 344). It follows, then, that when the timber was cut from the ravines and gorges a number of the lower layer plants of the climax associations were able to survive the lumbering process *only* in the relatively cool moist habitat provided by the deeper ravines, and not on the adjoining slopes where they had existed before the removal of the forest cover.

It should be pointed out, however, that the distribution of this group of species, and that of a large number of others, is closely correlated with the distribution of the most strongly acid soils in Columbia County; it is correlated as well with higher altitudes, with a shorter growing season and possibly with other factors, and the explanation proposed here may be far too simple.

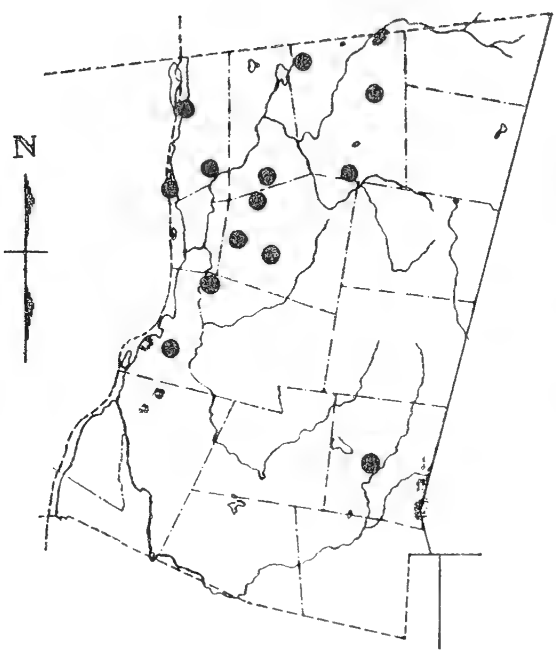

Figure 64. Map of Columbia County, showing the distribution of *Pellaea atropurpurea,* which is confined to outcrops of limestone rock. The distribution of this and a small group of other species is almost exactly that of the limestone outcrops.

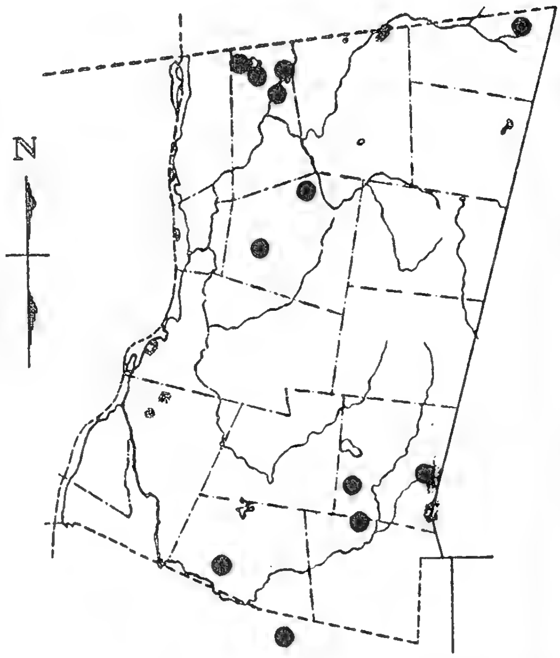

Figure 65. Map of Columbia County, showing the distribution of *Sarracenia purpurea,* a species characteristic of bogs.

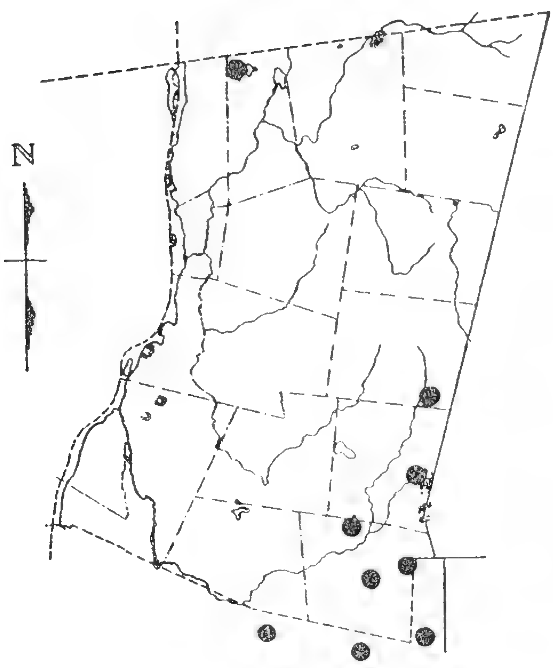

Figure 66. Map of Columbia County, showing the distribution of *Parnassia glauca.* This species is unknown in the area except in the calcareous marshes of the Harlem Valley and in a similar habitat in the town of Kinderhook.

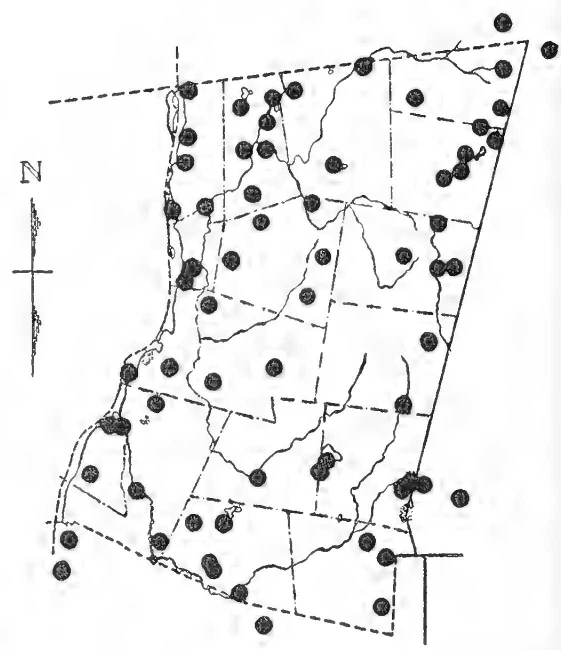

Figure 67. Map of Columbia County, showing the known distribution of the hemlock, *Tsuga canadensis.* This species is widely distributed and occurs in nearly every mature woodland in the entire area.

GEOGRAPHICAL RELATIONSHIPS OF THE FLORA

THE DISTRIBUTION OF THE SPECIES WITHIN THE COLUMBIA COUNTY AREA

As is brought out above (pp. 236 and figures 22-24), the area is divided into two rather well marked and nearly equal portions by the boundary which separates the nearly unchanged rocks of the Hudson Valley proper and the metamorphic rocks of the eastern half of the area. The eastern and western portions of the Columbia County area differ considerably in soils, topography and climate. As is to be expected, differences in vegetation accompany the other differences.

Most of the species of plants prove to have definite ranges even in such a small area. In the case of species restricted to certain habitats such as bogs, limestone rocks or lakes, a map of the distribution of the habitat is identical with that of the distribution of the species (figures 64–66). In the case of species of ordinary upland soils, or the species of moist lowland situations, for which suitable habitats are widespread, the types of distribution found are about as follows:

1. Species occurring throughout the area. This includes many of the plants designated as "frequent" and "common" in the systematic account of species. A typical range of this kind is that of the hemlock, *Tsuga canadensis,* as shown in figure 67. Between 400 and 450 native species belong in this group.

Following is a list of the principal native species and varieties occurring throughout the Columbia County area and found in most of the suitable habitats in that range. These are designated as "common."

Lycopodium obscurum
Equisetum arvense
Botrychium virginianum
Osmunda cinnamomea
Osmunda regalis
Onoclea sensibilis
Polystichum acrostichoides
Dryopteris marginalis
Dryopteris Thelypteris
Athyrium angustum
Pteridium latiusculum
Adiantum pedatum
Polypodium virginianum
Pinus Strobus
Pinus rigida
Tsuga canadensis
Typha latifolia
Potamogeton amplifolius
Potamogeton illinoensis
Potamogeton zosteriformis
Najas flexilis
Sagittaria latifolia
Anacharis canadensis
Festuca obtusa

Glyceria grandis
Glyceria melicaria
Glyceria striata
Poa palustris
Eragrostis pectinacea
Elymus virginicus
Hystrix patula
Danthonia spicata
Calamagrostis canadensis
Agrostis hyemalis
Oryzopsis racemosa
Aristida dichotoma
Phalaris arundinacea
Leersia oryzoides
Leersia virginica
Panicum linearifolium
Echinochloa crusgalli
Andropogon scoparius
Cyperus rivularis
Eleocharis obtusa
Scirpus atrovirens
Scirpus cyperinus
Carex vulpinoidea
Carex scoparia
Carex stipata
Carex pensylvanica
Carex platyphylla
Carex gracillima
Carex hirsutella
Carex stricta
Carex crinita
Carex comosa
Carex lurida
Carex intumescens
Arisaema triphyllum
Lemna minor
Juncus effusus
Juncus tenuis
Juncus acuminatus
Luzula multiflora
Uvularia perfoliata
Uvularia sessilifolia
Lilium canadense
Erythronium americanum
Maianthemum canadense
Smilacina racemosa
Polygonatum pubescens
Medeola virginiana
Trillium erectum
Smilax herbacea
Iris versicolor
Habenaria psycodes
Spiranthes gracilis
Corallorhiza gracilis
Juglans cinerea
Carya glabra
Populus tremuloides
Salix rigida
Salix sericea
Salix discolor
Ostrya virginiana
Carpinus caroliniana
Betula lenta
Betula populifolia
Alnus serrulata
Alnus rugosa
Fagus grandifolia
Castanea dentata
Quercus alba
Quercus Prinus
Quercus borealis
Ulmus americana
Pilea pumila
Boehmeria cylindrica
Asarum canadense
Polygonum arifolium
Polygonum punctatum
Polygonum sagittatum
Polygonum virginianum
Polygonum amphibium
Paronychia canadensis
Ceratophyllum demersum
Nymphaea odorata
Nuphar advena
Ranunculus abortivus
Ranunculus recurvatus
Ranunculus septentrionalis
Thalictrum dioicum
Thalictrum polygamum
Anemonella thalictroides
Hepatica americana
Anemone virginiana
Anemone quinquefolia
Clematis virginiana
Caltha palustris
Aquilegia canadensis
Actaea alba
Lindera Benzoin
Sanguinaria canadensis
Lepidium virginicum
Rorippa islandica
Cardamine pensylvanica
Dentaria diphylla
Dentaria laciniata

Penthorum sedoides
Saxifraga virginiensis
Mitella diphylla
Hamamelis virginiana
Spiraea latifolia
Spiraea tomentosa
Fragaria virginiana
Potentilla simplex
Potentilla norvegica
Geum canadense
Geum laciniatum
Agrimonia gryposepala
Rubus idaeus
Rubus occidentalis
Rubus odoratus
Rubus allegheniensis
Rubus flagellaris
Rubus hispidus
Amelanchier arborea
Crataegus macrosperma
Prunus pensylvanica
Prunus serotina
Prunus virginiana
Baptisia tinctoria
Desmodium glutinosum
Desmodium nudiflorum
Lespedeza intermedia
Amphicarpa bracteata
Geranium maculatum
Oxalis europaea
Polygala paucifolia
Polygala verticillata
Euphorbia vermiculata
Rhus Vernix
Rhus Toxicodendron
Rhus typhina
Celastrus scandens
Acer rubrum
Acer saccharum
Impatiens capensis
Tilia americana
Vitis riparia
Parthenocissus quinquefolia
Hypericum punctatum
Hypericum mutilum
Hypericum virginicum
Lechea intermedia
Viola fimbriatula
Viola pubescens
Viola palmata
Viola papilionacea
Viola blanda
Viola conspersa
Viola pensylvanica
Ludwigia palustris
Epilobium leptophyllum
Epilobium coloratum
Epilobium glandulosum
Oenothera biennis
Oenothera perennis
Circaea quadrisulcata
Aralia nudicaulis
Sanicula marilandica
Hydrocotyle americana
Cicuta bulbifera
Sium suave
Cryptotaenia canadensis
Zizia aurea
Cornus racemosa
Cornus Amomum
Cornus stolonifera
Monotropa uniflora
Rhododendron nudiflorum
Vaccinium angustifolium
Vaccinium vacillans
Lysimachia ciliata
Lysimachia quadrifolia
Fraxinus americana
Apocynum androsaemifolium
Apocynum cannabinum
Asclepias syriaca
Convolvulus sepium
Cuscuta Gronovii
Verbena hastata
Verbena urticifolia
Scutellaria lateriflora
Scutellaria epilobiifolia
Prunella vulgaris
Hedeoma pulegioides
Lycopus americanus
Mentha arvensis
Collinsonia canadensis
Chelone glabra
Mimulus ringens
Gratiola neglecta
Melampyrum lineare
Pedicularis canadensis
Utricularia vulgaris
Galium circaezans
Galium triflorum
Mitchella repens
Diervilla Lonicera

Lonicera dioica
Viburnum acerifolium
Viburnum recognitum
Sambucus canadensis
Triodanis perfoliata
Lobelia inflata
Lobelia spicata
Eupatorium perfoliatum
Eupatorium maculatum
Eupatorium purpureum
Eupatorium rugosum
Solidago altissima
Solidago arguta
Solidago bicolor
Solidago caesia
Solidago graminifolia
Solidago juncea
Solidago nemoralis
Solidago rugosa
Aster cordifolius
Aster divaricatus
Aster laevis
Aster puniceus
Aster undulatus
Aster lateriflorus
Aster simplex
Erigeron annuus
Erigeron canadensis
Erigeron strigosus
Antennaria canadensis
Antennaria plantaginifolia
Antennaria neglecta
Antennaria neodioica
Anaphalis margaritacea
Gnaphalium obtusifolium
Ambrosia artemisiifolia
Rudbeckia laciniata
Helianthus divaricatus
Bidens cernua
Bidens frondosa
Bidens vulgata
Achillea Millefolium
Xanthium orientale
Prenanthes alba
Hieracium paniculatum
Hieracium venosum

Following is a list of the principal native species and varieties occurring throughout the Columbia County area and found, for the most part, in 50 to 75 percent of the suitable habitats. These are designated as "frequent."

Lycopodium lucidulum
Lycopodium complanatum
Selaginella rupestris
Isoetes echinospora
Equisetum hyemale
Botrychium dissectum
Osmunda Claytoniana
Dennstaedtia punctilobula
Woodsia ilvensis
Woodsia obtusa
Cystopteris fragilis
Dryopteris cristata
Dryopteris intermedia
Dryopteris noveboracensis
Asplenium platyneuron
AspleniumTrichomanes
Athyrium thelypteroides
Sparganium americanum
Sparganium chlorocarpum
Potamogeton nodosus
Potamogeton natans
Potamogeton Spirillus
Potamogeton gramineus
Potamogeton praelongus
Bromus ciliatus
Bromus pubescens
Glyceria canadensis
Glyceria pallida
Eragrostis capillaris
Sphenopholis intermedia
Deschampsia flexuosa
Sporobolus vaginiflorus
Brachyelytrum erectum
Agropyron subsecundum
Elymus riparius
Muhlenbergia sobolifera
Panicum linearifolium var. *Werneri*
Panicum latifolium
Cyperus esculentus
Cyperus strigosus
Dulichium arundinaceum
Eleocharis acicularis
Eleocharis calva
Eleocharis elliptica

Scirpus validus
Eriophorum viridi-carinatum
Carex rosea
Carex cephalophora
Carex annectens var. *xanthocarpa*
Carex artitecta
Carex communis
Carex hirtifolia
Carex digitalis
Carex blanda
Carex granularis
Carex pallescens
Carex Swanii
Carex rostrata
Spirodela polyrhiza
Eriocaulon septangulare
Heteranthera dubia
Juncus tenuis var. *Dudleyi*
Juncus secundus
Juncus marginatus
Juncus nodosus
Juncus brachycephalus
Juncus canadensis
Juncus brevicaudatus
Veratrum viride
Allium tricoccum
Allium canadense
Hypoxis hirsuta
Sisyrinchium angustifolium
Sisyrinchium montanum
Cypripedium Calceolus
Orchis spectabilis
Habenaria lacera
Spiranthes cernua
Liparis Loeselii
Salix humilis
Salix nigra
Salix serissima
Carya ovata
Quercus bicolor
Populus grandidentata
Populus deltoides
Urtica dioica
Laportea canadensis
Comandra umbellata
Polygonum pensylvanicum
Caulophyllum thalictroides
Arabis laevigata
Ribes americanum
Ribes Cynosbati
Platanus occidentalis
Fragaria vesca
Potentilla argentea
Potentilla canadensis
Waldsteinia fragarioides
Geum aleppicum
Rosa carolina
Apios americana
Callitriche palustris
Ilex verticillata
Acer pensylvanicum
Ceanothus americanus
Vitis Labrusca
Viola sororia
Viola cucullata
Viola pallens
Dirca palustris
Aralia racemosa
Panax trifolius
Osmorhiza Claytoni
Cornus alternifolia
Cornus rugosa
Kalmia angustifolia
Vaccinium stamineum
Lysimachia terrestris
Fraxinus nigra
Asclepias incarnata
Asclepias quadrifolia
Satureja vulgaris
Pycnanthemum tenuifolium
Pycnanthemum virginianum
Lycopus uniflorus
Veronica americana
Veronica scutellata
Aureolaria virginica
Epifagus virginiana
Phryma Leptostachya
Galium asprellum
Galium lanceolatum
Cephalanthus occidentalis
Triosteum perfoliatum
Viburnum Lentago
Campanula rotundifolia
Campanula aparinoides
Solidago patula
Solidago gigantea
Aster Schreberi
Aster macrophyllus
Aster ericoides
Erigeron philadelphicus
Erigeron pulchellus
Sericocarpus asteroides

Antennaria munda
Gnaphalium uliginosum
Helianthus decapetalus
Erechtites hieracifolia
Senecio aureus
Cirsium muticum
Cirsium pumilum
Lactuca canadensis
Lactuca biennis
Prenanthes trifoliolata

2. Species abundant in the Hudson Valley but rare in or absent from the metamorphic region to the east. In most cases the members of this group occur also in the limestone region of the Harlem Valley but usually not in the high hills immediately to the east of it. The dividing line between the two halves of the county is not a sharp one, but species characteristic of the lowland areas of the Hudson Valley are ordinarily not found very far east of a line marked roughly by the 600-foot contour line (see figure 22), except in the Harlem Valley. At the eastern edge of the Harlem Valley, however, the break is a much sharper one; species common on the shale and limestone knolls of the valley may be quite absent on schistose rocks in the uplands a mile away. Distribution of this sort may be illustrated by the range of the hackberry, *Celtis occidentalis,* and the juniper, *Juniperus virginiana* (figures 68, 69). About 100 species fall into this group, with a considerable number of others having a similar but more restricted range in the county. Typical of this latter sort are *Cyperus filiculmis,* which occurs locally on sandy and shaly knolls at low elevations, the arbor-vitae, *Thuja occidentalis,* which is restricted to the shale bluffs in the immediate vicinity of the Hudson River, and the trefoil, *Lotus corniculatus,* which is confined to clay soils in the Hudson Valley (figures 70-72).

Following is a list of the principal species and varieties characteristic of the Hudson and Harlem Valleys. These are rare in or absent from the region of metamorphic rocks in the eastern and northeastern parts of the Columbia County area.

Dryopteris hexagonoptera
Juniperus virginiana
Alisma subcordatum
Bromus purgans
Elymus villosus
Elymus canadensis
Elymus Wiegandii
Cinna arundinacea
Panicum clandestinum
Panicum Gattingeri
Panicum lanuginosum var. *fasciculatum*
Panicum virgatum
Cyperus filiculmis
Carex retroflexa
Carex sparganioides
Carex tribuloides
Carex cristatella
Carex gracilescens
Carex conoidea
Carex amphibola
Carex lanuginosa
Carex squarrosa
Carex retrorsa
Carex Grayii
Carex lupulina
Symplocarpus foetidus
Peltandra virginica
Acorus Calamus
Pontederia cordata

Polygonatum canaliculatum
Trillium cernuum
Carya tomentosa
Carya cordiformis
Corylus americana
Ulmus rubra
Celtis occidentalis
Morus rubra
Quercus velutina
Polygonum scandens
Phytolacca americana
Ranunculus hispidus
Anemone canadensis
Cimicifuga racemosa
Liriodendron Tulipifera
Menispermum canadense
Podophyllum peltatum
Sassafras albidum
Cardamine bulbosa
Arabis canadensis
Arabis lyrata
Polanisia graveolens
Physocarpus opulifolius
Amelanchier humilis
Cassia hebecarpa
Amiphicarpa bracteata var. *comosa*
Strophostyles helvola
Desmodium canadense
Lespedeza capitata
Acalypha rhomboidea
Euphorbia maculata
Rhus aromatica
Rhus glabra
Staphylea trifolia
Acer saccharinum
Hypericum pyramidatum
Hypericum gentianoides
Cuphea petiolata
Sanicula canadensis
Sanicula gregaria
Taenidia integerrima
Zizia aptera
Cicuta maculata
Cornus florida
Nyssa sylvatica
Fraxinus pennsylvanica
Gentiana Andrewsii
Myosotis laxa
Hackelia virginiana
Trichostema dichotomum
Physalis heterophylla
Lindernia dubia subsp. *major*
Scrophularia lanceolata
Penstemon hirsutus
Mimulus alatus
Veronicastrum virginicum
Aureolaria pedicularia
Gerardia tenuifolia
Galium Aparine
Sicyos angulatus
Echinocystis lobata
Lobelia Cardinalis
Lobelia siphilitica
Mikania scandens
Eupatorium fistulosum
Solidago ulmifolia
Aster novae-angliae
Aster patens
Aster pilosus
Aster infirmus
Ambrosia trifida
Heliopsis helianthoides
Bidens connata
Helenium autumnale
Cirsium discolor
Krigia virginica

3. **Species abundant in the eastern half of the area, in the region of metamorphic rocks, but rare in or absent from the Hudson Valley.** These plants are rather less restricted in range than those of the group just discussed; many of them may be found very locally at isolated spots throughout the Hudson Valley, where they seem to represent relics of the old climax forest (see discussion, p. 366). They reach a considerable abundance, however, only in the hilly regions along the eastern edge of the county and are rarely found west of the boundary indicated by the 600-foot contour. In this group there are somewhat fewer than 100 species.

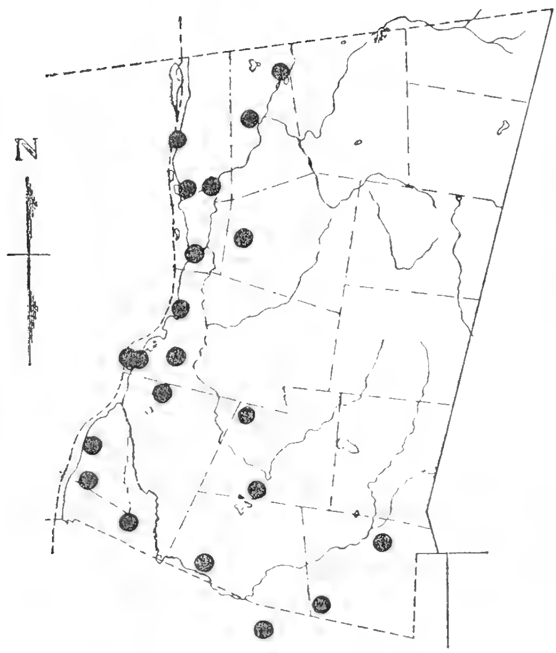

Figure 68. Map of Columbia County, showing the distribution of *Juniperus virginiana.* This tree is abundant throughout the Hudson Valley, particularly on clay soils, and extends into the Harlem Valley, but is rare or absent in the northern and eastern parts of the area.

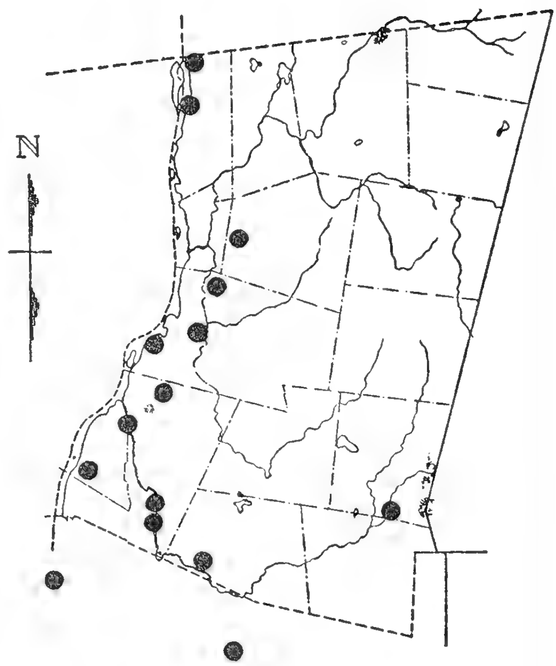

Figure 69. Map of Columbia County, showing the distribution of *Celtis occidentalis,* a species which is most abundant in the lower Hudson Valley, extending into the Harlem Valley and northward along the Hudson River.

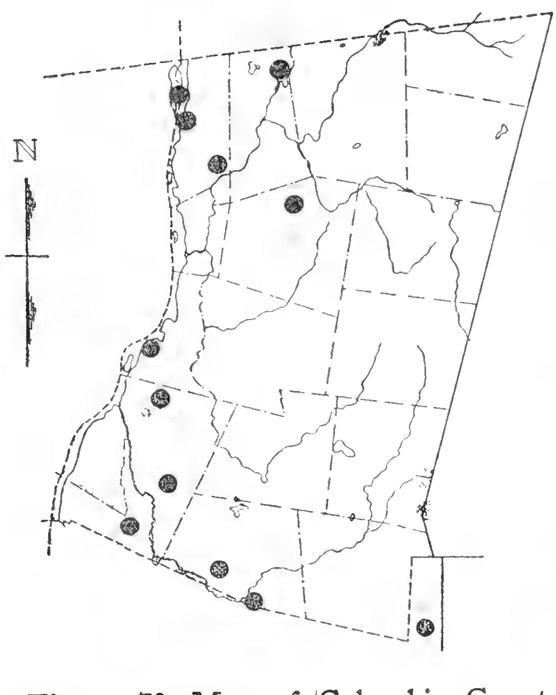

Figure 70. Map of Columbia County, showing the distribution of *Cyperus filiculmis.* This species is confined to sand and shale knolls in the Hudson and Harlem Valleys.

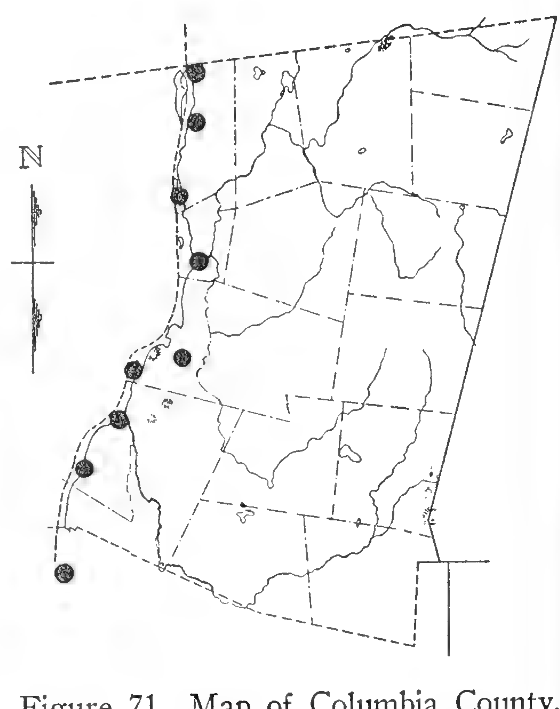

Figure 71. Map of Columbia County, showing the distribution of *Thuja occidentalis.* With one exception, an occurrence on Becraft Mountain, this species is confined to the bluffs and swamps along the Hudson River.

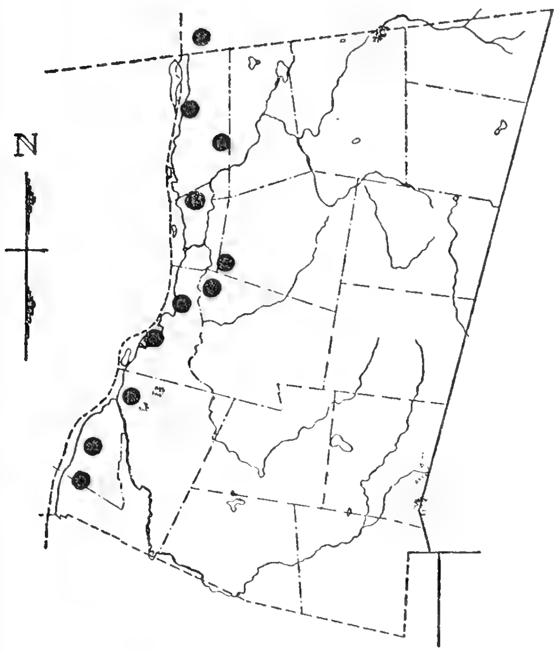

Figure 72. Map of Columbia County, showing the distribution of *Lotus corniculatus,* an introduced species which, in our area, is almost wholly confined to the clay soils of the Hudson Valley.

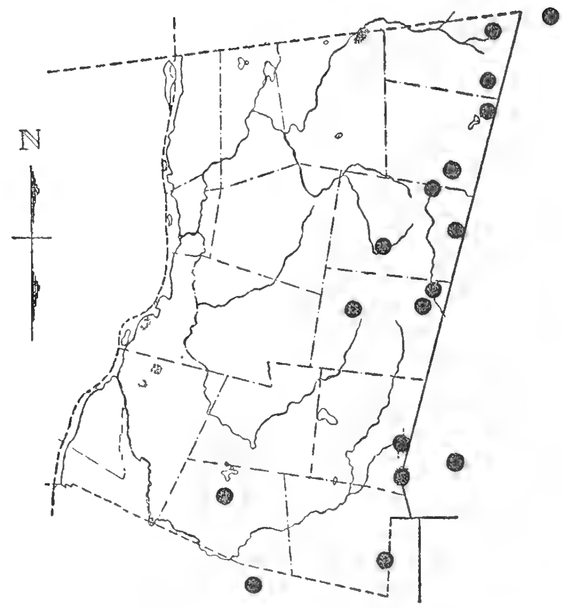

Figure 73. Map of Columbia County, showing the distribution of *Circaea alpina,* a species of cool shaded situations in the region of metamorphic rocks.

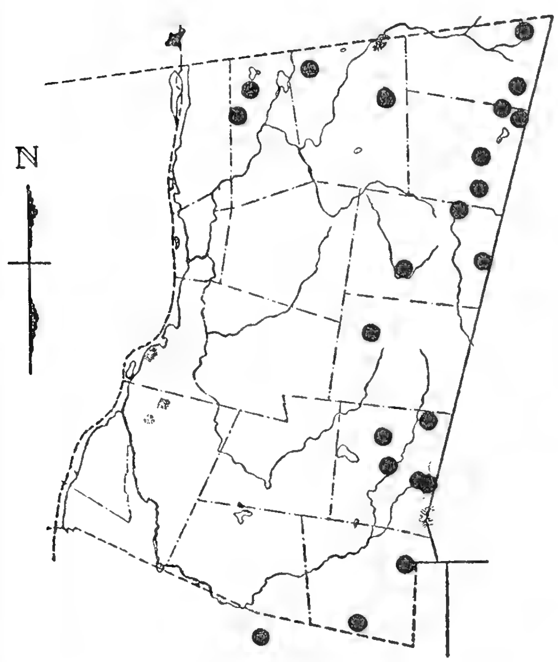

Figure 74. Map of Columbia County, showing the distribution of *Pyrola elliptica.* This species occurs abundantly on the acid soils at higher elevations in the region of metamorphic rocks, but is rare in the Hudson Valley.

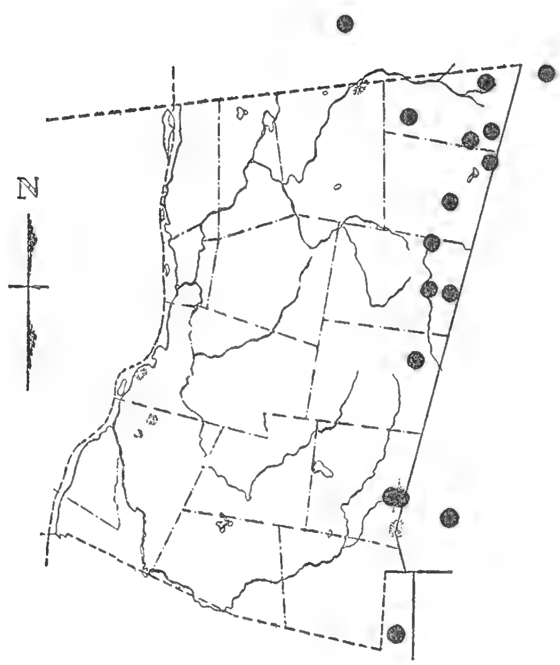

Figure 75. Map of Columbia County, showing the distribution of *Clintonia borealis.* This species is confined to the region of metamorphic rocks in the eastern part of the area, at elevations of 300 meters or more.

A good example of the general eastern range is furnished by the distribution of *Pyrola elliptica* or that of *Circaea alpina* (figures 73, 74).

In the eastern and northeastern parts of our region, at elevations of 1,000 feet (300 meters) or more, there may be recognized a considerable group of species having the same type of range as the above but much restricted. Such plants are rather closely confined to the eastern tier of towns, often ranging south to the gorge of Bashbish Brook in the town of Copake. An excellent example is *Clintonia borealis,* the dogberry (figure 75).

Following is a list of the principal species and varieties characteristic of the region of metamorphic rocks in the eastern and northeastern parts of the Columbia County area. These are rare or local in the Hudson and Harlem Valleys.

Lycopodium clavatum
Lycopodium annotinum
Lycopodium tristachyum
Dryopteris disjuncta
Dryopteris Phegopteris
Dryopteris spinulosa
Poa alsodes
Poa saltuensis
Danthonia compressa
Cinna latifolia
Muhlenbergia glomerata
Muhlenbergia tenuiflora
Muhlenbergia mexicana
Oryzopsis asperifolia
Panicum lanuginosum var. *implicatum*
Carex aestivalis
Carex arctata
Carex argyrantha
Carex laxiculmis
Carex leptonervia
Carex pedunculata
Carex prasina
Carex radiata
Carex scabrata
Carex torta
Luzula carolinae
Lilium philadelphicum
Clintonia borealis
Streptopus roseus
Trillium undulatum
Cypripedium acaule
Comptonia peregrina
Salix Bebbiana
Corylus cornuta
Betula papyrifera
Betula lutea
Quercus ilicifolia
Polygonum cilinode
Cerastium arvense
Sagina procumbens
Claytonia caroliniana
Coptis groenlandica
Corydalis sempervirens
Cardamine parviflora
Saxifraga pensylvanica
Tiarella cordifolia
Chrysosplenium americanum
Rubus pubescens
Sorbus americana
Aronia melanocarpa
Amelanchier laevis
Oxalis montana
Acer spicatum
Viola rostrata
Viola rotundifolia
Viola septentrionalis
Epilobium angustifolium
Circaea alpina
Cornus canadensis
Pyrola rotundifolia
Pyrola elliptica
Chimaphila umbellata
Kalmia latifolia
Lyonia ligustrina
Epigaea repens
Gaultheria procumbens
Vaccinium myrtilloides

Vaccinium corymbosum
Gaylussacia baccata
Trientalis borealis
Gentiana clausa
Gentiana quinquefolia
Asclepias exaltata
Monarda fistulosa
Aureolaria flava
Galium tinctorium
Galium trifidum
Houstonia caerulea
Viburnum alnifolium
Viburnum Opulus
Lonicera canadensis
Sambucus racemosa
Aster acuminatus
Senecio obovatus

4. Species confined to the bare rocky summits of the hills in a small area including the eastern edge of the towns of Copake, Ancram and Northeast and the adjacent parts of Massachusetts and Connecticut (for lists of species, see text, p. 324). Although few species are concerned, the type of vegetation in question is so distinct and its range so restricted that it seems worthy of illustrations. The general area in question may be seen by referring to the topographic map on page 237. Its extent is roughly that included within the 1,500-foot contour line. See also figure 76, which illustrates the range of *Potentilla tridentata.*

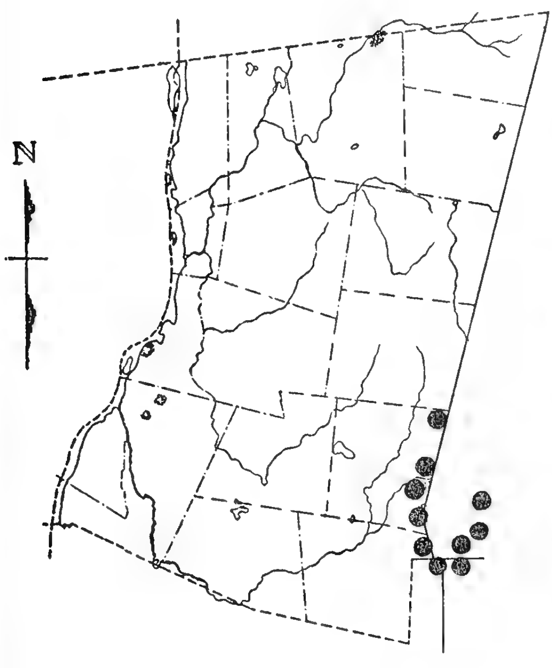

Figure 76. Map of Columbia County, showing the distribution of *Potentilla tridentata.* This species, in this area, is confined to the high rocky summits of the Taconics in New York and adjacent Massachusetts and Connecticut.

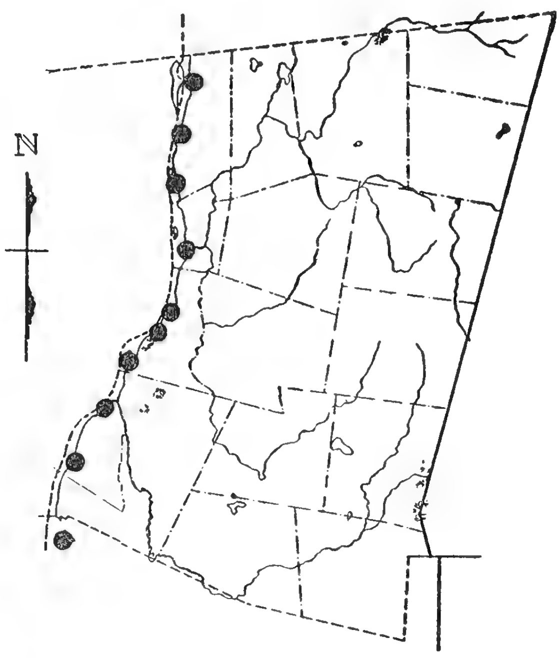

Figure 77. Map of Columbia County, showing the distribution of *Acnida cannabina,* a species confined to the tidal marshes of the Hudson estuary.

5. Species confined to the tidal marshes of the Hudson Estuary and their borders. As discussed previously, this group includes some 45 species, whose distribution may be illustrated by

that of *Acnida cannabina* (figure 77) (for lists of species, see text, p. 274).

There is, to be sure, a great deal of overlapping among the various types of distribution. On the whole, however, when a species becomes well enough known in the county so that one is able to discuss it adequately, in the majority of cases it may be arbitrarily assigned to one of the above categories. In general it may be said that the species characteristic of the Hudson Valley proper have, in large part, the approximate centers of their geographical ranges in the region of the deciduous forest, while the species which are more abundant eastward are most likely to be identified with the range of the eastern hemlock region as a whole.

THE FLORA OF THE COLUMBIA COUNTY AREA IN RELATION TO THE FLORA OF NEW YORK STATE AS A WHOLE

Local patterns of plant distribution, as exemplified by those in the Columbia County area, form a part of the general pattern of the vegetation of New York State. The factors which limit the ranges of species may be complex ones, but in general the principal ones are those of climate, of soil, and those relating to the history of the region. In New York the development of the vegetation has presumably been relatively recent, since the retreat of the glaciers. The influence of the soil on plant distribution is not easily distinguished from that of climatic factors, for in New York the physiographic and climatic provinces coincide approximately with soil regions. Highland or mountain areas are approximately the same as the areas in which acid soils predominate, so that one cannot characterize any individual species as a mountain plant without inferring that its usual habitat is a somewhat acid soil.

Whatever factors may have contributed to the formation of the pattern, the distribution of many species of plants in New York is shown in figure 78, which is a composite map based on the records in the herbarium of the New York State Museum. The 74 species whose ranges were plotted on the map are those which in the Columbia County area are widespread and characteristic species in the Hudson Valley, but rare or lacking eastward. Differences in elevation are indicated on the map by shading; elevations below 1,000 feet are shaded.

The composite map shows for these species a tendency toward concentration in lowland areas throughout the State, as contrasted to a scarcity of stations in the highlands. The species are well

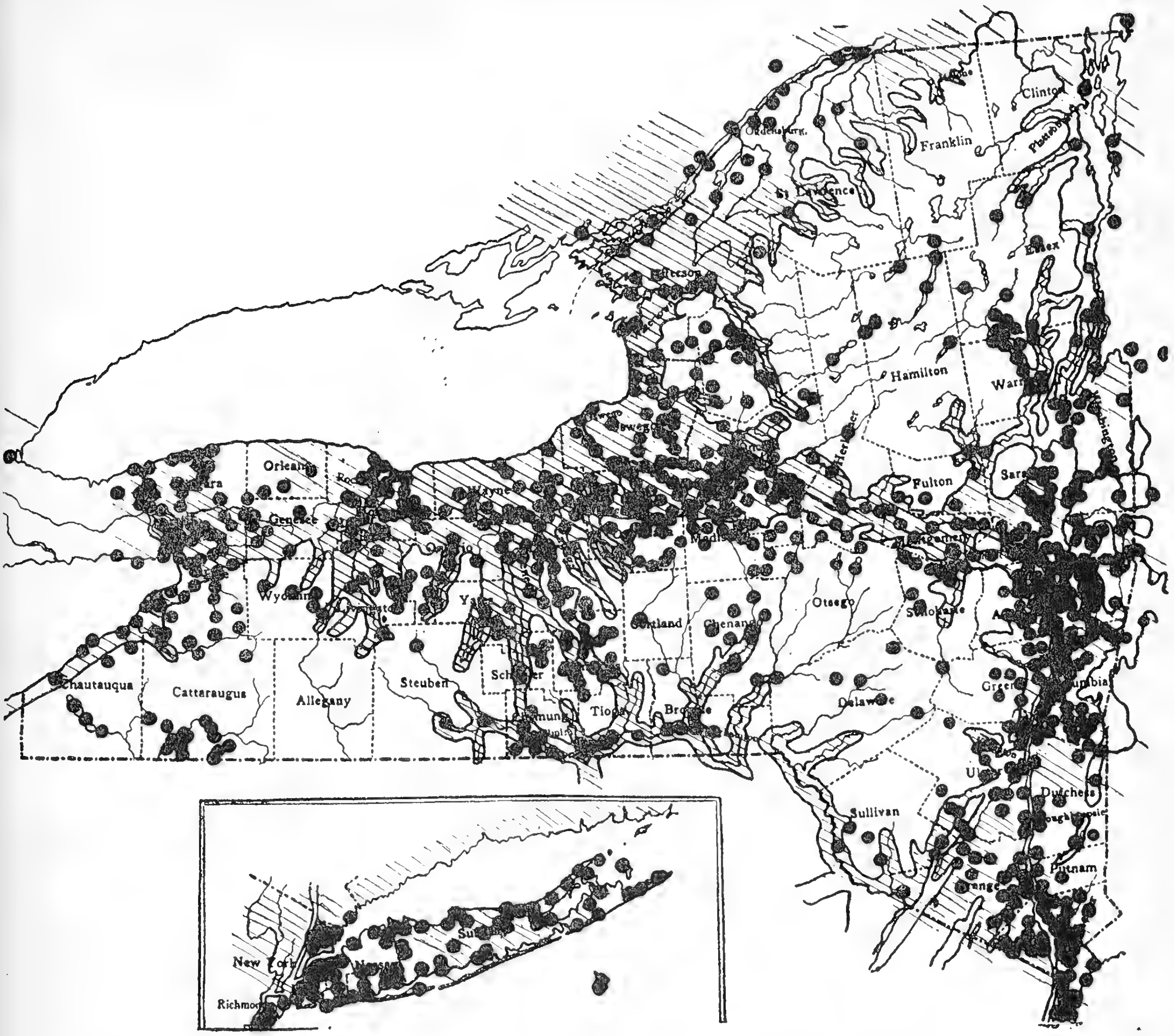

Figure 78. Composite map of the distribution in New York State of the following species, based on the records at the Herbarium of the New York State Museum:

Asplenium platyneuron
Asplenium Trichomanes
Juniperus virginiana
Typha angustifolia
Sparganium eurycarpum
Alisma subcordatum
Vallisneria americana
Cinna arundinacea
Bouteloua curtipendula
Sorghastrum nutans
Cyperus filiculmis
Arisaema Dracontium
Peltandra virginica
Symplocarpus foetidus
Acorus Calamus
Lilium canadense
Smilacina stellata
Carya tomentosa
Carya cordiformis
Corylus americana
Quercus velutina
Ulmus rubra
Celtis occidentalis
Morus rubra
Phytolacca americana
Ranunculus flabellaris
Ranunculus fascicularis
Ranunculus hispidus
Anemone canadensis
Cimicifuga racemosa
Liriodendron Tulipifera
Menispermum canadense
Podophyllum peltatum
Sassafras albidum
Cardamine bulbosa
Arabis canadensis
Ribes americanum
Physocarpus opulifolius
Cassia hebecarpa
Cassia nictitans
Polygala polygama
Rhus aromatica
Staphylea trifolia
Acer saccharinum
Hypericum pyramidatum
Opuntia humifusa
Ludwigia alternifolia
Sanicula canadensis
Sanicula gregaria
Taenidia integerrima
Cornus florida
Nyssa sylvatica
Chimaphila maculata
Fraxinus pennsylvanica
Asclepias verticillata
Myosotis laxa
Teucrium canadense
Isanthus brachiatus
Stachys tenuifolia
Penstemon hirsutus
Mimulus alatus
Veronicastrum virginicum
Aureolaria pedicularia
Pedicularis lanceolata
Sambucus canadensis
Sicyos angulatus
Lobelia siphilitica
Mikania scandens
Solidago speciosa
Solidago rigida
Ambrosia trifida
Heliopsis helianthoides
Helenium autumnale
Krigia virginica

distributed on Long Island, in the Hudson Valley, along the Mohawk Valley and in the Erie-Ontario-Mohawk plain (for a map of the physiographic subregions of New York, see Howe, 1935). The same species are known also in the St. Lawrence and Champlain lowlands as well as in the southern counties from Steuben County westward (this part of the State is technically the northernmost extension of the Appalachian Plateau).

Some imperfections in the map may be noted. More than ordinary concentrations of dots are seen about well-collected regions like the vicinity of Rochester, Buffalo and Allegany State Park in southern Cattaraugus County. Conversely, Allegany County itself is perhaps the least known botanically of any county in the State, and intensive collecting there would no doubt reveal a number of the species here plotted. The Catskill and Adirondack regions, however, have been rather extensively worked over by botanical collectors, especially the latter region, so that the map probably shows fairly well the true state of affairs for this part of the State. The same is true of the Hudson Valley, which, with the possible exception of parts of Dutchess County, has been more thoroughly collected.

Allowing for the imperfections of our knowledge and of the method, it appears that a considerable group of species is well distributed in lowland areas of New York State, including the territory north and west of the Adirondacks, but that the same species are not found to any extent in the more mountainous regions. Comparison of the figure just discussed with the next one (figure 79) will make evident the fact that this range corresponds roughly (except for the lower Hudson Valley and Long Island) with the distribution of lime-containing soils in New York. This figure shows clearly the acid soil region of the Adirondack Highland (A), the Tug Hill Plateau (B) and the Catskill-Pocono Highland (C). It also brings out the fact that the Northern Appalachian Plateau (D) has in general a similar type of soil. The extreme southwestern counties of the State, although shown in black on the map, lie in a region of less limy soil than that of central New York.

The reverse distribution may be illustrated by a composite map of the range of nine species which occur, in Columbia County, almost wholly at elevations above 1,000 feet in the eastern part of the area. Comparison of this map (figure 80) with the map of the 74 lowland species (figure 78) brings out the contrast between the two types of ranges. The more boreal species are concentrated in the Adirondack and Catskill regions, the Tug Hill Plateau and the highlands of Allegany and Cattaraugus Counties. They are absent from Long

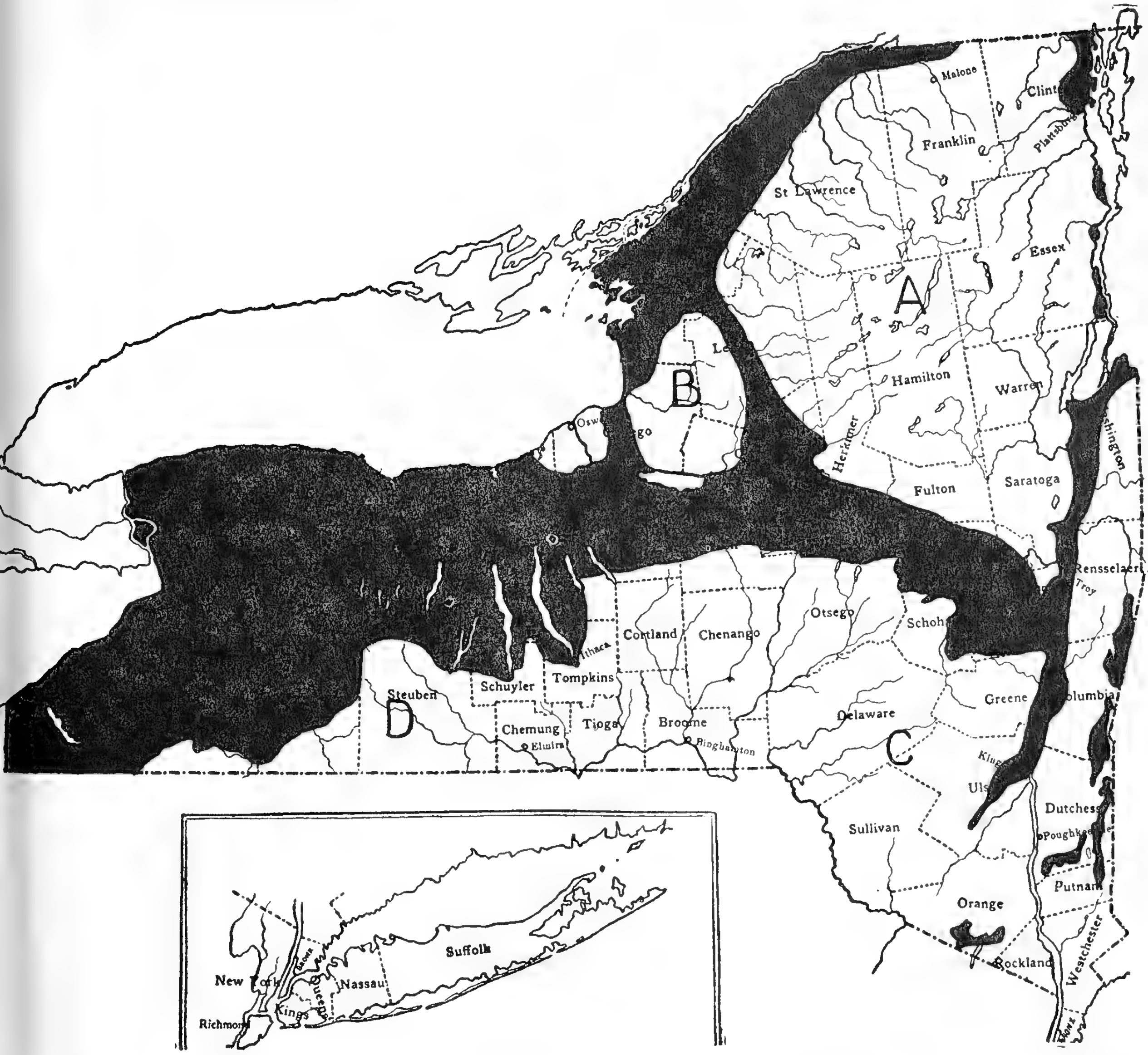

Figure 79. The distribution of lime-containing soils in New York State. (Data from the General Soil Map of New York, compiled by F. B. Howe, Department of Agronomy, Cornell University Agricultural Experiment Station, 1933). Principal areas of lime-containing soils are shown in black.

Island except for one doubtful record from Nassau County, rare in the Hudson Valley and along Lake Ontario and Lake Erie. As in the former map, there appears to be an undue concentration of dots around Ithaca and perhaps also in Rensselaer and Albany Counties, but, allowing for these and for the small number of species concerned, the map is thought to represent this type of distribution fairly accurately.

The above discussion may be summarized briefly as follows: the flora of the highland areas of New York may be segregated quite sharply from that of the lowland areas. The highland areas coincide approximately with areas of predominantly acid soils. The species of the lowland, ordinarily calcareous soils include a large percentage of those characteristic of the Hudson Valley part of Columbia County. Species of the more acid soils of the highlands of New York,

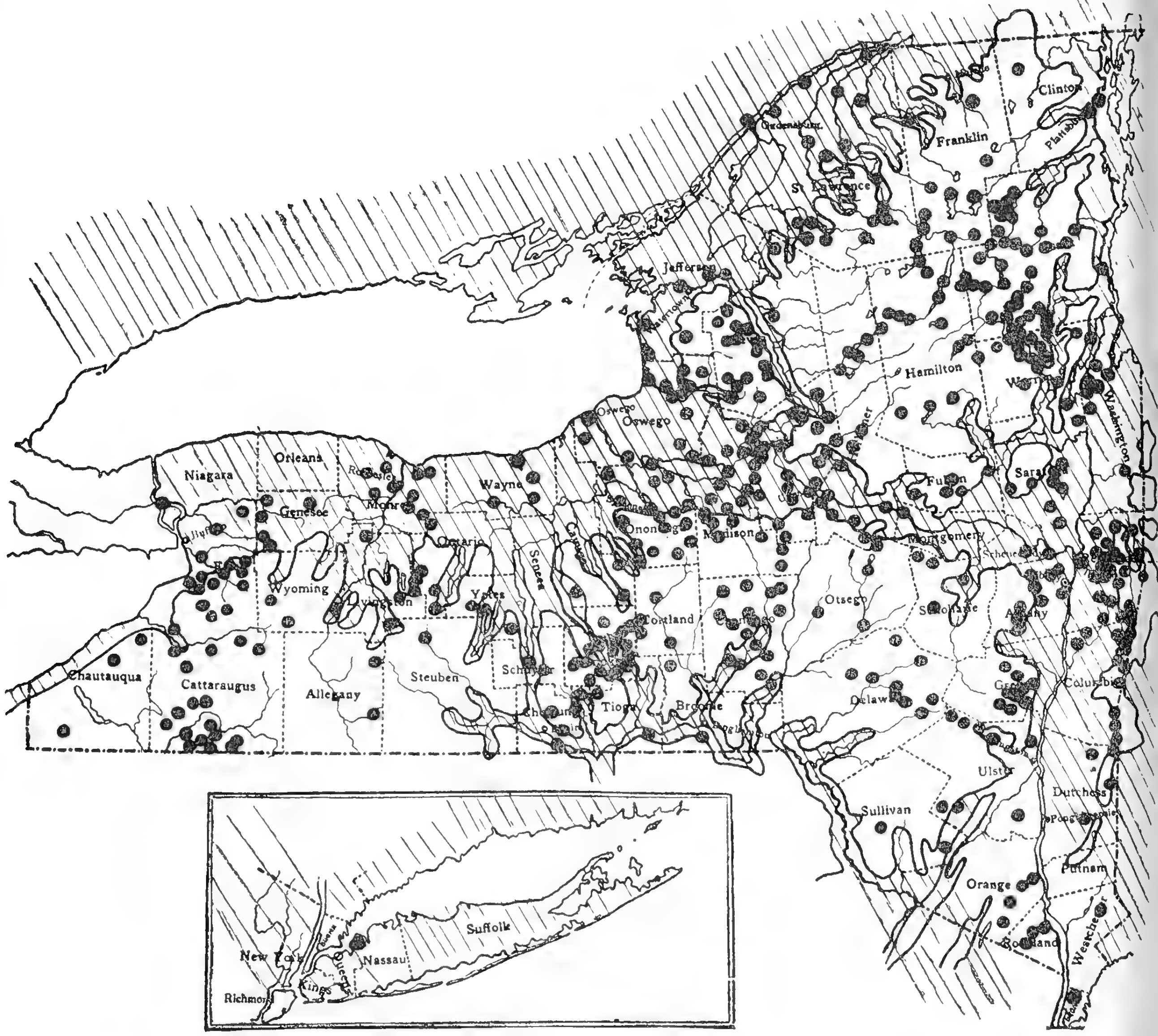

Figure 80. Composite map of the distribution in New York State of the following species, based on the records at the Herbarium of the New York State Museum: *Dryopteris disjuncta, Lycopodium annotinum, Clintonia borealis, Streptopus roseus, Trillium undulatum, Sorbus americana, Oxalis montana, Cornus canadensis* and *Viburnum alnifolium* (see text, p. 364)

if present in Columbia County, tend to be concentrated in the eastern half of the region rather than in the Hudson Valley.

THE CLIMAX VEGETATION

The climax vegetation of the part of southeastern New York which includes Columbia County has been generally stated to be a deciduous forest. Shreve (1917), followed by Livingston & Shreve (1921), maps the entire eastern section of the Hudson Valley as a part of the great deciduous forest which reaches its best development in the Appalachian Mountains. Climatically, Livingston & Shreve

include Columbia County in their "cool, semihumid" province of the United States; that is, where the number of days of the frostless season varies from 120 to 180 and the precipitation-evaporation ratio for the growing season ranges from a value of 0.6 to 1.0. Merriam (1894, 1898) places the western half of Columbia County (approximately what is here designated as the Hudson Valley) in his Carolinian Zone. The affinities of the flora and fauna he considers to be with the Appalachian-Ozark region. The eastern half of the county is placed by Merriam in his Transition Zone; that is, with the life intermediate in character between that of the Carolinian and Boreal. The affinity of the life of the Hudson Valley to that of the deciduous forest region is thus generally recognized.

Bray (1915) elaborates upon Merriam's thesis of temperature control of the distribution of plants and animals, and suggests several life zones for New York in particular. His Zone "B" includes all of the territory in our section east of the Hudson River. This zone is said to be characterized especially by the dominance of oaks, hickories, chestnut and tulip-tree; that is, by characteristic species of the deciduous forest. Zone "C" of Bray, his "Alleghany-Transition Forest Zone," said to be characterized by the dominance of sugar maple, beech, yellow birch, hemlock and white pine, is not shown to occur in Columbia County.

Analysis of available evidence indicates that the actual climax or climaxes occurring in our area are somewhat less closely related to the typical Appalachian deciduous forest than has been generally stated. Many characteristic Appalachian or Mississippi Valley species do not occur within the limits of our region. Examples of this are: *Quercus stellata, Asimina triloba, Hydrangea arborescens, Cercis canadensis, Gymnocladus dioica* and *Gleditsia triacanthos.* Many other species of similar affinities reach Columbia County only sparingly, and then only in the lowlands of the Hudson and Harlem Valleys: *Carya tomentosa, Quercus velutina, Celtis occidentalis, Morus rubra, Liriodendron Tulipifera* and *Nyssa sylvatica,* to name arboreal species only. On the other hand, the lists of trees and forest-floor herbaceous species given by Bray under Zone C (the "Alleghany-Transition Forest Zone") read like the enumerations of the common and widely distributed species of Columbia County.

It is apparent from these figures that, as far as can be determined from Bray's data, the characteristic species of Zone C, the "Alleghany-Transition Forest Zone," are much more generally present and widely distributed in Columbia County than those of any other of his life zones. On the other hand, over 70 percent of the plants cited

Table 21

Distribution of Indicator Species Cited by Bray (1915) for Zones B, C, D and E.

Occurrence in Columbia County	Zone B	Zone C	Zone D	Zone E
Generally distributed	22%	75%	26%	0
Found eastward and northeastward only	6	15	60	62.5%
Found in Hudson and Harlem Valleys only	29	3	0	0
Absent from flora or doubtful.......	43	7	14	37.5
	100	100	100	100
Total number of species cited by Bray	49	60	27	16

under Zone B are absent from the flora entirely or occur only in the Hudson and Harlem Valleys.

Further inspection of the table indicates that our area must be considered as a tension zone or transition zone between a climax type like Zone B (still using Bray's terminology) and one like Zone D. Indicator species of Zone D are most highly developed at the greatest elevations eastward and northeastward, while those of Zone B are most frequent in the Hudson Valley. This idea of a tension zone was indeed included in Merriam's work, where the Hudson Valley was considered the northernmost extension of the Carolinian Zone. Bray himself indicates that his distinctions may be too arbitrary in nature and that more detailed local study is needed.

It seems probable that the forest climax in the Hudson Valley part of Columbia County closely approximates the "Lake Forest" of Weaver and Clements (1929). The dominant trees are said to be white pine, hemlock and red pine with one of the two first-named species often forming nearly pure stands; the pitch pine (*P. rigida*) is said to enter the community southward. In the Hudson Valley as here considered, practically any mature woodland shows a heavy preponderance—both in size and in number of individuals—of white pine and hemlock. The latter tends to become dominant in older stands, as mentioned above, while white pine will take over large areas quickly, often forming nearly pure stands of young trees. In age, mixed stands of white pine and hemlock often contain a few trees each of red pine and pitch pine. The relation to the deciduous forest is shown by the presence, even in mature stands like the one described above (p. 306), of relatively small percentages of such trees as *Quercus alba* and *Q. borealis, Fagus grandifolia, Acer sac-*

charum and *A. rubrum, Betula lenta, Carya ovata* and *C. glabra,* and *Fraxinus americana.* At the present time, hemlock-white pine forests make up the bulk of the existing mature or nearly mature stands throughout the county. They are well represented even at higher elevations such as the steep mountainside above the old Shaker settlement at Mount Lebanon. Here, at 450-540 meters elevation, the hemlock and pine predominate, with occasional red oak and mature paper birch intermingled. If the county area is to be considered as a whole, it appears that the general climax is a white pine and hemlock forest, with small percentages of various deciduous trees, little undergrowth and generally acid conditions on the forest floor.

It is suggested in the preceding pages that there is some possibility of a "tension zone" between the deciduous forest climax of the eastern United States and the evergreen Canadian forest. The former is dominated by relatively long-lived trees, including such species as tulip poplar, beech, several species of oaks and hickories, black cherry, magnolia and formerly chestnut. The forest usually comprises several well marked layers of arboreal, shrubby and herbaceous species, and is characterized by a wealth of species.

North of the boundaries of the deciduous forest, and extending in a great belt from southern Labrador and the Maritime Provinces westward and northwestward to the Mackenzie River, the boreal forest is dominated by relatively few, mostly short-lived trees, the principal ones being balsam fir, white spruce, black spruce and paper birch. Layer societies of woody plants are poorly developed, and the whole number of species concerned is relatively small.

The zone of transition between these two forested regions has been the subject of much study, and there has been considerable confusion as to its nature and boundaries. It may be necessary to designate a third type of climax forest, coordinate with the two mentioned above but somewhat more closely related to the deciduous than to the boreal type. The forests of the "eastern hemlock region," as this area was named by Nichols in 1935, are marked by the dominance of a number of species which are more or less endemic in the region and thus ordinarily not members of the climax forest flora in any other region. The most characteristic trees of this group are the hemlock, *Tsuga canadensis,* the eastern white pine, *Pinus Strobus,* the yellow birch, *Betula lutea,* sugar maple, *Acer saccharum,* and beech, *Fagus grandifolia.* Of this group of five species only the beech has its center of distribution in the deciduous forest.

In addition to the dominant arborescent species mentioned above, there is a large number of other plants which occupy a similar, fairly well defined geographic range. As early as 1911, Fernald pointed

out that well over 300 continental species of this sort were confined to a range extending in general from Minnesota and Manitoba to New Brunswick or Nova Scotia, south to northern Illinois, southern Michigan and in the mountains to North Carolina or Georgia. The boundaries of this geographic area correspond well with those outlined by Nichols for the eastern hemlock region (figure 81). It will be noted from the figure that the Columbia County area lies within the hypothetical "eastern hemlock region," with its southern edge roughly 30 miles north of the southeastern boundary of the latter.

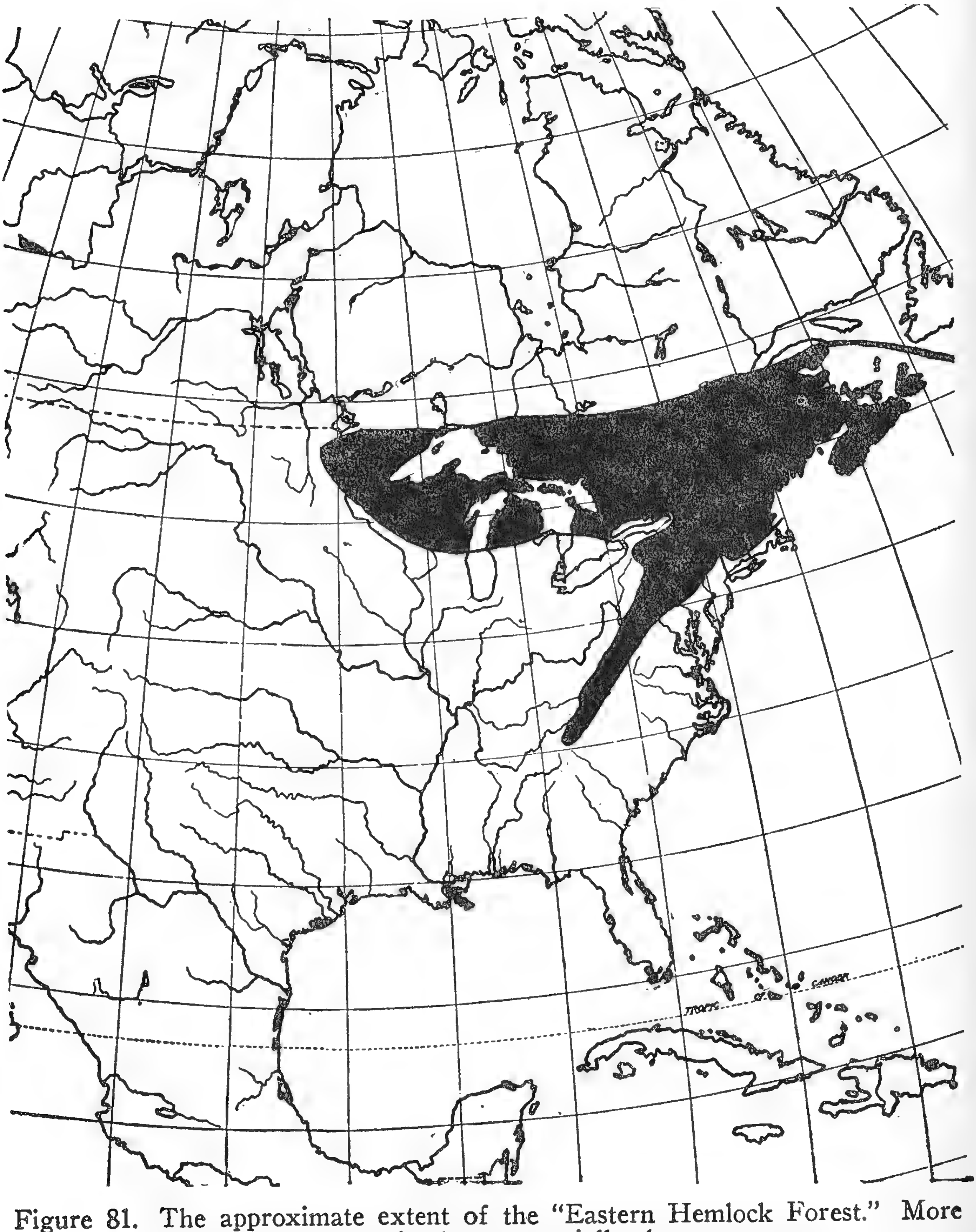

Figure 81. The approximate extent of the "Eastern Hemlock Forest." More than 300 native species have essentially the same range.

It should be possible, then, through a study of the various components of the flora of the Columbia County area, to establish its relationship to one or more of the types of climax forest discussed above. The vascular flora of the Columbia County area, so far as is now known, comprises 1,357 named species and varieties.[1] Of this number 735 occur rarely, or are poorly understood as to distribution in the area, or occupy specialized habitats such as sphagnum bogs, exposed rocks or the like. This includes also 93 generally distributed species which are either a) clearly not members of the native flora or b) generally distributed in North America and so of minor importance in the present discussion. The remaining 622 species and varieties, or about 45 percent of the entire flora, are sufficiently known so that definite statements may be made as to their distribution and abundance within the county. With few exceptions they are plants of rather wide occurrence; that is, they are found naturally in ordinary upland soils or in wetter soils of the lowlands rather than in extreme acidic or basic soils, or under conditions of extreme xerophytism or hydrophytism.

In the first place we may consider the group of 622 species mentioned above as being the best known component of the native flora. The relative and absolute abundance of each species is approximately known, and each has a definite range in the area. As the group comprises about 45 percent of the entire number of species present, and includes those species which are most abundant and widespread within the area, it may be seen that a consideration of this element of the flora should thus include a very large percentage of the total number of plants in the region.

A second approach is through the more than 500 species which are less widely distributed in the region. Rare species in a given region may be rare because they are approaching the edge of their geographical range, because of unsuitable climatic or edaphic factors or for other reasons not clearly understood. Studies of the natural ranges of these rare or local species may help to establish the proper understanding of the vegetation of the region in which they grow.

First let us consider the large group of native species and varieties, each of which is known to be relatively widespread in ordinary

[1] All the tabulations and calculations in the following paragraphs pertain to the account as written up before revision in 1949, at which time a few entities were added and a few deleted. The totals remain approximately as before, the only changes having taken place among the species which are rare or poorly known from the area.

TABLE 22

Part 1. Tabulation of the Flora of the Columbia County Area

	SPECIES AND VARIETIES
Common throughout the area	333
Frequent throughout the area	172
Species of Hudson and Harlem Valleys, less abundant eastward	110
Species abundant eastward, less so in Hudson and Harlem Valleys	84
Species locally abundant throughout the range, mostly weedy in nature	80
Rare or local species, mostly confined to specialized habitats or poorly known	578
Total native and introduced species and varieties	1,357

Part 2. Tabulation of the Native Species and Varieties of the Area

	SPECIES AND VARIETIES
Common throughout the area	277
Frequent throughout the area	156
Species of the Hudson and Harlem Valleys	105
Species abundant eastward, less so in Hudson and Harlem Valleys	84
Species of local abundance, mostly weedy in nature	21
Rare or local species, mostly confined to specialized habitats or poorly known	489
Total native species	1,132

(nonspecialized) habitats within our area. These may be separated arbitrarily into the following classes:

1. Species designated as common. Such species occur throughout the range, and are to be expected in nearly all suitable habitats in the area (see list, p. 351).

2. Species designated as frequent. These occur also throughout the range, but are met with in not more than 50 to 75 percent of the suitable habitats (list, p. 354). There is naturally some intergradation between these two arbitrary groups ("common" and "frequent"), and it is not always possible to separate them.

3. Species generally distributed in the Hudson Valley proper, but infrequent, rare or unknown in the region of metamorphic rocks to the eastward (list, p. 356; for a description of the limits of the Hudson Valley, see pp. 237, 238).

4. Species generally distributed in the region of metamorphic rocks, but infrequent, rare or unknown in the Hudson Valley (list, p. 360).

Most of the 622 species fall into the following additional classes based upon their generalized or average geographical distribution:

1. Species occupying approximately the range of the deciduous forest; that is, from New England, New Brunswick or Nova Scotia westward mostly south of the Great Lakes to southern Michigan and eastern Minnesota, southeast of the prairies to eastern Oklahoma and eastern Texas. Plants with this general range may be locally rare in the Appalachian Mountains and on the acid soils of the Atlantic Coastal Plain, and are most characteristically species of the rich soils of the interior.

2. Species occupying approximately the range of the eastern hemlock region as defined by Nichols and described above; such plants extend from Newfoundland or Nova Scotia or rarely from eastern Quebec or Labrador, westward mostly north of the Great Lakes to the north side of Lake Superior, the forested regions of southern Manitoba and northern Minnesota, southward to eastern Iowa, locally to Illinois and Indiana, New Jersey and Pennsylvania and in the mountains to North Carolina or Georgia. Plants included in this group are in some cases found outside the limits just defined, extending well north into Labrador or even to Alaska, but such cases are relatively few and the species in question are not more characteristic of the boreal forests than of the forests of the eastern hemlock region.

3. Boreal species, ranging from Newfoundland or Labrador to Hudson Bay and Alaska, south in the east to the northern United States, or more rarely to the Appalachian Mountains.

4. Wide-ranging species of temperate North America, ranging mostly from Newfoundland to British Columbia, southward in some cases throughout the United States.

Table 23 gives the general geographical distribution of the 622 species considered in the present discussion.

Analysis of the table brings out the fact that about half the native species designated as "common" or "frequent" in the Columbia County area have the approximate centers of their ranges in the eastern deciduous forest, while only about one-fifth of the same group of species center in the eastern hemlock forest, and about 5 percent of the whole number of species have distinctly boreal affinities.

If we now consider the Hudson Valley separately, it is seen that nearly three-quarters of the species characteristic of that part of the area have their distributional centers in the deciduous forest region, indicating that this part of Columbia County has much closer affinities with the deciduous forest area than does the county as a whole.

TABLE 23

Geographical Distribution of 622 Native Species Known To Be Widespread in the Columbia County Area

DISTRIBUTION IN COLUMBIA COUNTY AREA	TYPE OF RANGE (GENERAL GEOGRAPHICAL DISTRIBUTION)				
	DECIDUOUS FOREST	EASTERN HEMLOCK	BOREAL	WIDE RANGING	MISC.
Common	149	58	13	51	6
(277)	([1]54%)	(21%)	(5%)	(18%)	(2%)
Frequent	71	40	9	28	8
(156)	(45%)	(26%)	(6%)	(17%)	(5%)
Hudson Valley	78	10	1	10	6
(105)	(74%)	(10%)	(1%)	(10%)	(6%)
Eastward	13	48	15	7	1
(84)	(16%)	(57%)	(18%)	(8%)	(1%)

[1] Percentage values are given to the nearest unit.

If, on the other hand, the eastern half of the county is considered separately, the contrast is striking. Of the characteristic species here, less than one-sixth have their centers of distribution in the deciduous forest, while about 18 percent of the species have distinct boreal affinities. Here over half the typical species have ranges nearly corresponding with that of the eastern hemlock region, as against the tenth part of the Hudson Valley species which have similar ranges.

When the Hudson Valley and the eastern half of the area are considered separately, as has been done immediately above, the picture obtained is somewhat exaggerated due to the fact that the *common* and *frequent* species, which occur throughout both parts of the region, are not included in the calculation. A truer picture may be obtained by combining the figures for *common* and *frequent*, first with those for the Hudson Valley and secondly with those for the eastern half of the Columbia County area. This should give the status of the whole group of species generally distributed in the Hudson Valley as well as that group of species generally distributed eastward. The results are shown in table 24.

These figures indicate that in the Hudson Valley there are more than 2.5 species characteristic of the deciduous forest for every 1 centering in the eastern hemlock region. In the eastern half of Columbia County the ratio is somewhat smaller, about 1.5:1, indicating a somewhat more distant relationship with the deciduous forest. If we were concerned here with equal numbers of species in the deciduous forest region and in the eastern hemlock region, the above ratios would express rather well the degrees of affinity between the

TABLE 24

Geographical Affinities of Hudson Valley Species Contrasted with Those Generally Distributed Eastward

	RANGE OF DECIDUOUS FOREST	RANGE OF EASTERN HEMLOCK REGION	BOREAL SPECIES
Common plus *Frequent* plus *Hudson Valley*	55%	20%	4%
Common plus *Frequent* plus *Eastward*	45%	28%	7%

two halves of our area and the two forest regions in question. As a matter of fact, however, the number of species commonly associated with the climax forest of the eastern hemlock region is considerably smaller than the number characteristic of the rich deciduous climax type. We must accordingly ascertain, if we can, what proportion of the species characteristic of the climax types in question are also characteristic of our area.

In the first place let us consider the composition of the climax forest of the "eastern hemlock region." Although published accounts of the vegetation of virgin forest areas are distressingly few, there are at least two which apply directly to the present problem. One is a description of a beech and hemlock forest which formerly stood in northwestern Connecticut, almost immediately adjacent to the Columbia County area (Nichols, 1913; see page 306 above). The second is a study of Heart's Content, a virgin tract in northwestern Pennsylvania (Lutz, 1930). By comparing the lists of species reported from these areas with Nichols' description of the climax vegetation of the eastern hemlock region, it is possible to arrive at fairly definite conclusions as to the most characteristic species. These species number 52, including only those common to any two of the above three lists (table 25).

Of these 52 species, 32, or 62 percent, are generally distributed in the Columbia County area; included are all the dominant forest trees, viz.: white pine, hemlock, yellow birch, black birch, beech, chestnut, red oak, black cherry, red maple, sugar maple, basswood and white ash. Included also are the most characteristic understory shrubs and herbs like *Hamamelis virginiana, Acer pensylvanicum, Aralia nudicaulis* and *Viburnum acerifolium.* The remaining 20 species are all widespread and of usual occurrence in the eastern metamorphic region of the Columbia County region, but are infrequent, rare or absent in the Hudson Valley. As discussed above (p. 293),

TABLE 25

List of the Most Characteristic Species of the Eastern Hemlock Region. See text, page 375.

Polypodium virginianum	*Actaea alba*
Polystichum acrostichoides	*Tiarella cordifolia*
Dryopteris noveboracensis	*Hamamelis virginiana*
Dryopteris spinulosa	*Dalibarda repens*
Botrychium virginianum	*Prunus serotina*
Lycopodium lucidulum	*Oxalis montana*
Lycopodium obscurum	*Acer saccharum*
Taxus canadensis	*Acer rubrum*
Pinus Strobus	*Acer spicatum*
Tsuga canadensis	*Acer pensylvanicum*
Brachyelytrum erectum	*Tilia americana*
Arisaema triphyllum	*Viola rotundifolia*
Clintonia borealis	*Aralia nudicaulis*
Smilacina racemosa	*Cornus alternifolia*
Maianthemum canadense	*Pyrola elliptica*
Streptopus roseus	*Monotropa uniflora*
Medeola virginiana	*Gaultheria procumbens*
Trillium erectum	*Trientalis borealis*
Trillium undulatum	*Fraxinus americana*
Cypripedium acaule	*Epifagus virginiana*
Betula lutea	*Mitchella repens*
Betula lenta	*Lonicera canadensis*
Fagus grandifolia	*Viburnum acerifolium*
Castanea dentata	*Viburnum alnifolium*
Quercus borealis var. *maxima*	*Sambucus racemosa*
Coptis groenlandica	*Aster acuminatus*

there is some evidence to show that many species, now mostly confined to the mesophytic woodlands of the more hilly parts of the metamorphic region to the eastward, were much more abundant, even within historic times, in the Hudson Valley. Accordingly, it is probable that had the present study been made two centuries ago, conditions over the whole area would have been found to be more uniform than at present. Most if not all of the 52 species just mentioned probably were formerly much more abundant in the whole Hudson River Valley region of eastern New York. If, then, the eastern hemlock forest is to be considered an entity, as distinct from the boreal and deciduous climax types, it appears from the above discussion that the Columbia County area must be included in it.

There is no evidence whatever that the climax vegetation of this part of the Hudson River drainage, south of central Rensselaer County, is related to the boreal or Canadian forest type. Balsam fir

is unknown in the Columbia County area except along its northeastern boundary; white spruce is not a member of the flora; black spruce and larch exist only in a few highly specialized habitats. The herbaceous components of the flora of the boreal climax type are either scarce or absent in the same area. *Oxalis montana,* for example, which is a conspicuous and common plant in the Adirondack woods, is exceedingly rare in eastern Columbia County, while the twin flower, *Linnaea,* has never been reported from this part of New York.

On the other hand, most of the species which dominate the climax deciduous forest are represented in Columbia County, although not all, by any means, are common. As stated above, about half the total number of species known to be characteristic of the Columbia County area have their centers of distribution in the area occupied by the deciduous forest. Only a little more than a quarter of the same group of species have their centers of distribution in the eastern hemlock region. Exact figures are not available concerning the whole numbers of species occupying these two types of ranges, but it is probable that at least twice as many species have the foci of their ranges in the deciduous forest region as in the eastern hemlock region. In the climax forest itself, so far as is shown by published accounts, the number of species in the virgin hemlock type appears to be one-half to three-quarters the number present in the deciduous climax.

Following this reasoning, the two floristic elements seem to be rather evenly balanced in the Columbia County flora, and, further, relatively little stress may be laid on the actual whole number of species concerned. Of far more importance appear to be the considerable groups of species and genera which are not common to the two types of forest and which thus serve to emphasize the break between them. Short lists of some of the conspicuous examples of this sort are appended:

I. Genera and species characteristic of some or all of the region occupied by the deciduous forest but sparsely represented or lacking in the eastern hemlock region and wholly lacking as native plants in the Columbia County area:

Cheilanthes	*Isopyrum*	*Jeffersonia*
Paspalum	*Delphinium*	*Stylophorum*
Scleria	*Aconitum*	*Heuchera*
Tradescantia	*Xanthorhiza*	*Philadelphus*
Disporum	*Magnolia*	*Hydrangea*
Aristolochia	*Calycanthus*	*Gillenia*
Clematis, sect. *Viorna*	*Asimina*	*Malus*

Gymnocladus
Gleditsia
Amorpha
Robinia
Vicia
Ptelea
Euonymus
Aesculus
Ascyrum
Erigenia
Oxydendrum
Dodecatheon
Diospyros
Obolaria
Phacelia
Phlox
Liatris
Silphium
Coreopsis

II. Genera and species characteristic of the eastern hemlock region and of the Columbia County area but sparsely represented or lacking in the deciduous forest region:

Lycopodium
Taxus
Pinus Strobus
Tsuga canadensis
Thuja
Clintonia borealis
Betula (except *B. nigra*)
Tiarella
Dalibarda
Pyrola
Gaultheria

The diversity between the two forest types is further evidenced by the floristic makeup of individual climax deciduous forests of which there are a few available accounts in literature. Practically all of these have appeared in recent years (since 1930), and all deal with the region of the lower Great Lakes or the Ohio Valley. Three separate forest areas have been selected as representative. The first of these was located (1933) in Berrien County, in southern Michigan (see Cain, 1935); the other areas were in southern Indiana. All three areas seem to be favorably located for discussion in comparison with the forests of the eastern hemlock region, as all are but a few hundred miles south of the main westward extension of this forest as mapped by Nichols (1935, p. 405). Moreover, the deciduous forest, in practically typical form, extends eastward from the above points into extreme western New York, where it meets the typical eastern hemlock forest.

Warren's Woods, a virgin beech and maple tract in Berrien County, Mich., has been the subject of several floristic and faunistic studies. It lies in a region with a growing season of about 180 days (Cain, 1935, p. 501) and a mean annual rainfall of 31.11 inches. This may be compared with an average growing season of 163 days and a mean annual precipitation of 38.86 inches at Hudson, N. Y. The average snowfall of the region of Warren's Woods is 51.6 inches, as against 53.8 inches at Hudson, N. Y.

The dominant species of the upper arboreal layer of Warren's Woods, according to Cain, are *Acer saccharum, Fagus grandifolia, Acer rubrum, Ulmus americana, Prunus serotina* and *Quercus borealis* var. *maxima*. *Fraxinus americana, Tilia glabra* [*T. americana*]

and *Carya cordiformis* are also represented by considerable numbers of individuals. *Ulmus fulva* [*rubra*], *Liriodendron Tulipifera* and *Celtis occidentalis* are scarce. In the inferior arborescent layer the species represented by the largest number of individuals are *Carpinus caroliniana, Ostrya virginiana* and *Prunus americana.* The most abundant tall shrub is *Lindera Benzoin. Viburnum acerifolium* is an important low shrub, with *Lonicera canadensis* a poor second.

The herbaceous species of Warren's Woods, including only those appearing in 20 percent or more of the quadrats studied, are:

PLANT	FREQUENCY, PERCENT
Arisaema triphyllum	64
Dryopteris intermedia	64
Carex plantaginea	56
Galium Aparine	56
Smilacina racemosa	36
Polystichum acrostichoides	20
Carex pensylvanica var. *lucorum*	20
Caulophyllum thalictroides	20
Osmorhiza Claytoni	20
Viola papilionacea	20

A total of 78 species is recorded by Cain from the area in question. It is noteworthy that all except four of these are well represented in eastern New York in the Columbia County area. In fact, the description of Warren's Woods could well pass for that of an immature forest, particularly a swamp forest, in Columbia County. Even more noteworthy, however, is the complete absence of many species and even genera which make up so large an element of even the immature forests of eastern New York: *Tsuga, Pinus* and *Betula,* to mention the most conspicuous of the dominant arborescent elements. Less important but equally interesting is the lack of such genera as *Taxus, Lycopodium* and *Pyrola.*

In summation, Warren's Woods is dominated by a group of species most of which are also common in eastern New York. The greatest single difference between the two areas appears to lie in the fact that many species and genera characteristic of the "eastern hemlock region" are wholly absent from this deciduous forest in southern Michigan. Since several of the missing species are those which dominate the climax forest a little farther east, there is evidently a considerable difference in aspect and floristic composition of the two climax types.

The second tract of virgin deciduous forest to be discussed was described by Cain (1934) from studies made in 1932 and 1933. Nash's Woods is situated in Posey County, Ind. The undisturbed

area totals about 15 acres. The dominant species of the upper arboreal layer are said to be *Liriodendron Tulipifera, Quercus alba, Nyssa sylvatica* and *Acer saccharum,* these four species comprising 43 percent of the number of stems and constituting 65 percent of the total basal area. Next most important are "*Ulmus fulva* [*rubra*], *Fraxinus lanceolata* [*pennsylvanica* var. *subintegerrima*], *Sassafras variifolium* [*albidum*], *Liquidambar Styraciflua* and *Carya cordiformis,* constituting together 23 percent of the total basal area and 30 percent of the total number of stems." Especially important in the inferior arborescent layer are "*Cornus florida, Carpinus caroliniana, Sassafras variifolium* and *Cercis canadensis. Morus rubra, Asimina triloba, Celtis laevigata* and others are of less importance." Shrubs are "*Sambucus canadensis, Benzoin aestivale* [*Lindera Benzoin*], *Corylus americana, Viburnum prunifolium, Evonymus atropurpureus.*" *Rhus Toxicodendron* and *Parthenocissus quinquefolia* are said to cover extensively the forest floor, often excluding herbaceous vegetation. Common herbs are "*Geum canadense, Circaea latifolia* [*quadrisulcata*], *Arisaema triphyllum, Polygonum virginianum, Pilea pumila, Laportea canadensis, Asarum canadense,* etc." In the survey of June-July, 1932, a floristic list of 110 species is given. Excluding questioned and uncertain records, there remain 102 species, of which not more than 75 *occur at all* in the Columbia County area except as introductions. Of those occurring, at least 22, or nearly one-third of the total number common to the two areas, are found in the Columbia County area only in the lowlands near the Hudson River, and never in the higher lands farther east.

A third study of a deciduous forest was that located at Turkey Run State Park, Parke County, Ind. (Esten, 1932). This tract of 4.5 acres was found to be dominated by *Fagus,* with a large admixture of *Acer saccharum.* Its general floristic composition was much like that of the Nash's Woods area described immediately above. The species listed as occurring in the forest totaled about 110, of which not more than 85 occur in Columbia County or adjacent areas in eastern New York.

After comparison of the descriptions of these hardwood forests with that of the supposed climax in eastern New York, it seems that there is sufficient justification for the separation of the "eastern hemlock forest" as a distinct climax type. The number of species present in the deciduous forest is at least a third greater than the number present in the eastern hemlock forest. There is comparative scarcity of species common to the two types in the same relative abundance. Among the dominant trees and shrubs, only *Acer saccharum* plays an important part in both. Among herbaceous species

no more than nine are common to the Colebrook Forest as it formerly existed and to Nash's Woods.

The conclusion is that the climax vegetation of the Columbia County area is a mixed forest containing conifers and hardwoods, essentially identical with the "eastern hemlock forest" of Nichols and, secondly, that this type of climax forest deserves recognition as a type coordinate with the deciduous forest climax.

Brief attention may now be given the group of approximately 500 native species which are poorly known, rare, or local in the Columbia County area. Approximately 300 of these occupy little-specialized habitats, including ordinary upland soils and wetter soils of lowlands. When the geographical ranges of these species are determined as accurately as possible, they seem to fall into much the same groups as do the better known elements of the Columbia County flora. Nearly half of the 300 occupy roughly the same range as that of the deciduous forest, and about one-fourth of them coincide in range with the eastern hemlock forest. Few if any additional inferences can be drawn from a study of this group.

The most important remaining groups of the flora are those inhabiting specialized habitats, as follows:

1. **The flora of sphagnous bogs.** There are about 50 species, of which 30, or about 60 percent, are wide-ranging northern species, often occupying a transcontinental range north of the United States, in glaciated territory. The remainder is made up of several elements, including a number of species with coastal plain and inland distribution in the eastern United States (e.g., *Calopogon pulchellus*), and a few species having essentially the range of the eastern hemlock forest (*Eriophorum virginicum, Arethusa bulbosa*) but occurring also in the coastal plain. Lists of the principal species concerned will be found on pages 289, 290.

2. **The flora of calcareous marshes.** The peculiar flora of this habitat comprises about 36 species, exclusive of widely distributed marsh plants. Of these, 20, or about 56 percent, have their centers of distribution in glaciated territory north of our area. About half of these are widespread or transcontinental species occurring in calcareous regions. The remainder is made up of diverse elements, including about 5 species more or less coincidental in range with the eastern hemlock forest, and 3 having essentially the range of the deciduous forest. Lists of the principal species concerned will be found on pages 300, 301.

3. **The flora of tidal marshes and their borders.** This part of the flora, again excluding widely distributed marsh plants, includes

45 species, of which 19, or nearly 45 percent, are estuarine and coastal species of eastern North America. Eight species, which in our area are mostly confined to the tidal marshes, are wide-ranging palustrine plants. Nine are species of the deciduous forest area, here nearing their northeastern limits. Lists of the principal species concerned will be found on pages 274, 277.

4. **True aquatics. Plants of lakes, ponds and streams.** In our area there are about 35 such species known from a few localities only, as well as about 20 additional species which are well known in suitable habitats throughout. Of the total of more than 50 species, about 30 have the centers of their ranges north of our area, in glaciated territory. Seven additional species are wide-ranging species which occur over considerable areas both north and south of the moraine. Hardly more than 10 percent of the aquatics are of restricted range, and most of these are confined roughly to the area of the deciduous forest.

ORIGIN OF THE FLORA

With the last retreat of the Pleistocene ice from New York, the area was thrown open for occupancy by plants. Glaciation was severe enough to make it improbable that any considerable amount of vegetation survived the Wisconsin ice age in this region. According to current theory, the Appalachian region of the southeastern United States has constituted a vast reservoir of plant life from which the flora of the coastal plain, as well as much of that of the glaciated territory to the north, has been derived.

As the Wisconsin ice sheet receded, the exposed territory probably comprised bare rocks, mixed glacial till consisting of large and small rock fragments and, finally, water-laid sands and clays. Studies of modern Alaskan glaciers indicate that these ancient glacial "soils" were probably highly deficient in organic matter (Cooper, 1923), although the organic remains of earlier vegetation buried by the glaciers may have existed in the lower strata.

The receding ice front was probably followed rather closely by pioneer plants, similar to those occupying Arctic regions today. The most efficient pioneers were doubtless those plants having light windblown spores such as mosses, or fluffy seeds or fruits like the willows and some of the composites. The first plants which could invade the newly exposed land successfully were those able to withstand the low temperatures that probably prevailed near the melting glacier and those able to maintain themselves as seedlings in the rocky, humus-poor substratum (Cooper, 1923, pp. 228-32).

The hardy pioneer species were followed relatively soon by other, less adaptable ones which could become established only after the climate had moderated somewhat and a certain amount of humus-rich soil had been built up through the activity of the more hardy species. A few short-lived arborescent species, including balsam fir and spruce, probably became the dominant forest trees and we may conjecture that a spruce and balsam forest occupied much of what is now eastern New York for the first few thousand years following the retreat of the glaciers. Depressions in the forests were presumably filled by characteristic bog vegetation. Water-filled depressions of all sorts were more numerous than at the present time, and lakes and ponds were more conspicuous features of the landscape.

As the climate moderated, and melting of the glaciers continued, plants unable to stand the subarctic conditions near the ice were able to invade the area from the south. The relatively short-lived trees of the balsam and spruce forest were superseded by hemlock and pine and the more adaptable hardwoods, all of which had survived glaciation in the Appalachian region. With the establishment of hemlock, pine and their associates, the species of the boreal forest presumably were unable to compete with those characteristic of the hemlock forest and also were superseded.

According to this view, we may think of the Columbia County area as having been occupied by successive waves of plant immigrants; the first wave was doubtless a small one in number of species, consisting of those plants with easily transported seeds. Following these we should expect the plants best able to survive under the existing conditions; in our area, as stated above, those species characteristic of the present-day boreal regions. The character of the invading species then doubtlessly changed; more plants appeared which were suited to temperate climates. With each succeeding influx, some of the species already present were crowded out of existence, being unable to stand the competition under the new conditions set up. Only where conditions remained nearly the same as before were the original invaders able to persist.

With the above theories in mind, we may return to the actual figures for the flora of the Columbia County area. The species with extensive boreal ranges are found today in Columbia County for the most part in highly specialized habitats: in highly acid or basic soils, under conditions of high soil sterility, submersed in water (aquatics), etc. These habitats have been essentially unchanged since first invaded by plants; they have been modified by the presence of the plants themselves, but the plants of ordinary upland and lowland soils have not been able to enter them. As a consequence,

we find such relic species comprising less than 10 percent of the whole number of species of woodland or other mesophytic habitats, while making up 50 to 60 percent of the flora of sphagnum bogs, calcareous marshes and strictly aquatic habitats. Over an area such as the one under discussion, habitats of these sorts are necessarily limited in occurrence and all the species confined to them are found but locally.

A second and much more important element in the flora of the Columbia County area is that group of species whose centers of range lie not far from eastern New York, in the eastern hemlock region. These are the species which seem ecologically best suited to the region. Very few of them are near the geographical edges of their ranges and, if the ecological balance remains undisturbed, the expectation is that they may play considerable parts in the climax vegetation. They are more numerous in ordinary upland and lowland habitats than in bogs and the like. At the present time roughly one-fourth of all the species native in such nonspecialized habitats have this type of range.

The third important element in the flora is that comprised by the species whose centers of range lie somewhere in the eastern United States, in the region occupied by the deciduous forest. This is a large group, its members making up approximately half the total number of species native to ordinary habitats in our area. It is probable that most of these species would play smaller roles in the climax vegetation than they do in the subclimax associations of today. A number of species of this third and large group are found in Columbia County only very locally and may represent more or less extreme outposts of the deciduous forest vegetation.

In addition to these three rather large elements of the flora, there are several less important ones which may be mentioned briefly. These include:

a. A few western species, extending locally eastward to New York or New England. Included are such things as the widespread prairie grass, *Bouteloua curtipendula,* and a number of semiweedy adventives like *Plantago aristata* and *Linum sulcatum.* More recent introductions from the west include *Cycloloma atriplicifolium* and other plants doubtless scattered along railroad rights-of-way. Most of the truly western or plains species, however, are obviously of very recent introduction and so of little importance in the consideration of the native flora.

b. An element made up of widespread species which often occur throughout North America, or extend from coast to coast, at least in temperate regions. An estimated 10 to 15 percent of the native

flora belongs to this group, which includes all the common native species which are now weedy and characteristic of roadsides, paths, dooryards, fields and cut-over woodlands. Although including a good sized block of species, this wide ranging element has not been included in the discussion of floristic relations, as the individual species differ greatly in habitat requirements and associates and because so many of them are weedy in nature.

c. A small number of species native to our area, found most characteristically on the coastal plain of southeastern United States. Most of these are plants of acid sandy soil or of acid bogs and extend locally northward through eastern New York. This element of the flora is not large, numbering not more than 20 species.

d. Estuarine species. This element of the flora, as discussed above, is not large, numbering fewer than 20 species. Geographically these plants have doubtless reached our area from the southward, traveling up the Hudson Estuary.

e. The weed flora. In any intensive study of the vegetation of an area, especially in a region long settled or devoted to agriculture, the question of the weedy element of the flora becomes a pertinent one. This is especially true when the native vegetation comprises, as it does in eastern North America, many relatively conservative species—9 species, that is, which do not readily adapt themselves to new conditions set up by the practices of agriculture, lumbering and so on. Under conditions of this sort, native species are often largely replaced in areas of disturbed soil by aggressive introduced species which are able to thrive in the new environment. As a consequence, cleared or cultivated land in a region of this kind is often marked by the presence of numerous introduced species.

The original meaning of the word "weed" was *a rank or wild growth* (from the Anglo-Saxon weōd). From this has come the present usage in which a weed is understood to be a plant growing in cultivated or other ground to the detriment of the desired vegetation or to the disfigurement of the place. It is obvious, therefore, that a plant is not fundamentally a weed; someone has said, "A weed is a flower out of place." Many of our weeds were first introduced as garden ornaments or as herbs, and have since spread widely. The list of weeds, however, is not by any means made up wholly of introduced species. A number of native plants eked out an existence in clearings and light shade when the original forest covering was dense in all of eastern North America. These have taken to pasture, meadowland and roadside and spread widely, so that nowadays they are ordinarily associated with these habitats. Con-

spicuous examples are furnished by the goldenrods (various species of *Solidago*) and by the Indian tobacco (*Lobelia inflata*).

On the other hand, intolerant native species such as certain sphagnophilous orchids and sedges have disappeared from the better drained and pastured districts, and we know of their existence there solely through old records and studies of the general distribution of these plants. Many species are considered weedy because the less adaptable native plants are unable to compete with them under less favorable conditions of light and relative humidity. A fine example of this is furnished by the native species of *Rubus* (raspberries and blackberries), which form impenetrable tangles in every new clearing in the woods. Species which are tolerant of a wide range of environmental conditions are sufficiently aggressive to have spread considerably. Their numbers have increased far beyond those of the more conservative species. The most outstanding of such species may be found in list III, below.

In the following lists and discussions of weed species, numerous introduced plants have been omitted because they occur only occasionally or are not established in our area and so are not to be considered as important weeds. These plants are to be found, however, in their proper places in the systematic part of this study.

I. Weeds of gardens, orchards and "hoe crops" (corn etc.), which are able to persist under cultivation by means of copious seed production (or, in a few cases, underground rhizomes or strong perennial roots). Mostly annuals.

Eragrostis cilianensis
Agropyron repens
Digitaria sanguinalis
Echinochloa crusgalli
Setaria lutescens
Polygonum pensylvanicum
Polygonum Persicaria
Chenopodium album
Amaranthus retroflexus
Amaranthus hybridus
Amaranthus albus
Mollugo verticillata
Portulaca oleracea
Capsella Bursa-pastoris
Lepidium virginicum
Raphanus Raphanistrum
Trifolium repens
Oxalis europaea
Malva neglecta
Abutilon Theophrasti
Hibiscus Trionum
Apocynum cannabinum
Asclepias syriaca
Convolvulus sepium
Datura Stramonium
Linaria vulgaris
Ambrosia artemisiifolia
Xanthium orientale
Erigeron canadensis
Heilanthus tuberosus
Bidens frondosa
Bidens vulgata
Galinsoga ciliata
Anthemis Cotula
Arctium minus

II. Weeds of pastures, meadows and roadsides. Often perennials, which crowd out desirable forage species.

Bromus tectorum
Agropyron repens
Echinochloa crusgalli
Scirpus atrovirens
Carex stricta
Juncus effusus
Allium vineale
Saponaria officinalis
Ranunculus acris
Potentilla recta
Rubus flagellaris
Medicago lupulina
Melilotus alba
Melilotus officinalis
Trifolium agrarium
Trifolium arvense
Vicia tetrasperma
Vicia villosa
Euphorbia Cyparissias
Hypericum perforatum
Daucus Carota
Pastinaca sativa
Zizia aurea
Cuscuta Gronovii
Echium vulgare
Origanum vulgare
Thymus Serpyllum
Verbascum Thapsus
Plantago lanceolata
Galium Mollugo
Dipsacus sylvestris
Cichorium Intybus
Tragopogon pratensis
Hieracium florentinum
Hieracium pratense
Hieracium aurantiacum
Ambrosia artemisiifolia
Erigeron annuus
Erigeron strigosus
Inula Helenium
Rudbeckia hirta
Achillea Millefolium
Chrysanthemum leucanthemum
Tanacetum vulgare
Cirsium vulgare
Cirsium arvense
Centaurea Jacea
Centaurea maculosa

III. Weeds generally distributed in waste places in dooryards, fields and cultivated grounds; more details as to habitat and distribution of these species may be found in the systematic section. Most of these species are of less economic importance than the foregoing; the majority of the native weedy species are to be found here.

Dennstaedtia punctilobula
Pteridium latiusculum
Equisetum arvense
Equisetum hyemale
Eragrostis pectinacea
Dactylis glomerata
Agrostis alba
Muhlenbergia frondosa
Panicum Gattingeri
Panicum capillare
Setaria viridis
Cyperus esculentus
Cyperus strigosus
Juncus bufonius
Juncus tenuis
Urtica dioica
Rumex Acetosella
Rumex crispus
Rumex obtusifolius
Polygonum aviculare
Polygonum Hydropiper
Polygonum Convolvulus
Scleranthus annuus
Stellaria media
Cerastium vulgatum
Silene Cucubalus
Lychnis alba
Sisymbrium officinale
Barbarea vulgaris
Brassica nigra
Potentilla canadensis
Potentilla simplex

Potentilla norvegica
Oxalis europaea
Euphorbia maculata
Euphorbia vermiculata
Lythrum Salicaria
Cuphea petiolata
Oenothera biennis
Apocynum androsaemifolium
Convolvulus arvensis
Verbena urticifolia
Nepeta Cataria
Nepeta hederacea
Leonurus Cardiaca
Lamium amplexicaule
Physalis heterophylla
Solanum Dulcamara
Plantago major
Lobelia spicata
Lobelia inflata
Taraxacum officinale
Ambrosia trifida
Sonchus oleraceus
Solidago rugosa
Solidago juncea
Solidago altissima
Solidago nemoralis
Solidago graminifolia
Bidens cernua
Anthemis Cotula
Tussilago Farfara

IV. Woody or shrubby species, mostly indigenous, which spread rapidly into old fields, pastures, clearings and fence rows and are of little or no value.

Comptonia peregrina
Betula populifolia
Alnus rugosa
Spiraea latifolia
Spiraea tomentosa
Potentilla fruticosa
Rubus idaeus
Rubus occidentalis
Rubus allegheniensis
Prunus virginiana
Prunus pensylvanica
Robinia Pseudo-Acacia
Ailanthus altissima
Rhus typhina
Rhus glabra
Rhus Toxicodendron
Cornus racemosa
Sambucus canadensis

V. Weeds found principally in grain fields. The main species concerned are *Bromus secalinus* (chess) and the cockle, *Agrostemma Githago*. To these may be added the wild radish, *Raphanus Raphanistrum,* and the summer mustard, *Brassica Kaber,* which are very difficult to eradicate when once established.

VI. Aquatic weeds. In lakes and ponds and in the shallow bays of the Hudson River a dense growth of aquatic vegetation is often troublesome to fishermen and campers, so that the problem of its removal is sometimes a serious one. The principal species concerned are the pondweeds (*Potamogeton* spp.), "eel-grass" (*Vallisneria americana*) and the river weed (*Anacharis canadensis*).

The Origin of the Weed Flora

As pointed out above, many weedy species are native in the area under consideration but have been able to spread widely from their original habitat to agricultural lands. Of the 162 species listed as weeds on the foregoing pages, 71 are apparently native to eastern New York.

Of the remaining 91, 3 (*Eragrostis pectinacea, Echinochloa crus-galli, Solanum Dulcamara*) are doubtfully indigenous in our area and 88 are introductions. According to the data given in the "Catalogue of the Flowering Plants and Ferns of Connecticut" (Graves, *et al.*, 1910), 78 of the introductions came from Europe and the remaining 10 originated as follows: Tropical America, 4 (*Amaranthus*, 2 sp.; *Mollugo; Galinsoga*); Asia, 2 (*Abutilon Theophrasti, Datura Stramonium*); western United States, 2 (*Rudbeckia hirta, Helianthus tuberosus*); southeastern United States, 1 (*Robinia Pseudo-Acacia*); China, 1 (*Ailanthus altissima*).

While in number of species the introduced weeds hardly surpass the native ones, in number of individuals there is no such comparison. Only about six native species are to be considered really troublesome weeds in our area, as follows:

Rubus flagellaris
Convolvulus sepium
Ambrosia artemisiifolia
Erigeron canadensis
Bidens frondosa
Achillea Millefolium

The dewberry, when it gets a start in dry fields and pastures, is difficult to eradicate and rapidly makes the land useless for grazing. The bindweed is a bad pest among fruit growers of the Hudson Valley as it spreads rapidly and forms tangles in the orchards. The ragweed, apart from its much publicized connection with hay fever, spreads very rapidly into cultivated grounds, as do the horseweed and *Bidens*. The yarrow, omnipresent in grassland and pastures, is useless and replaces more valuable plants.

Of the introduced weeds, some 16 species are pests in farmland (only the most persistent and troublesome species are included):

Agropyron repens
Digitaria sanguinalis
Allium vineale
Ranunculus acris
Brassica Kaber
Raphanus Raphanistrum
Hypericum perforatum
Daucus Carota
Pastinaca sativa
Galium Mollugo
Cichorium Intybus
Rudbeckia hirta
Chrysanthemum leucanthemum
Cirsium arvense
Centaurea maculosa

In numbers of individuals, this group far outnumbers any other. If we could clear the fields of these 16 species the weed problem in the Columbia County area would be reduced to a minimum. It is interesting in this connection to note that the weed flora of our area has become relatively stable; that is to say, most of the so-called "weeds" are generally distributed and have been so for some years. A study of the list of introduced weeds shows that apparently fewer

than 20 are new to the State since Torrey's "Flora of New York" (1843). The species which were seemingly unknown to Torrey from New York are as follows:

Bromus tectorum	*Thymus Serpyllum*
Amaranthus retroflexus	*Galium Mollugo*
Silene Cucubalus	*Tragopogon pratensis*
Lychnis alba	*Hieracium florentinum*
Potentilla recta	*Hieracium pratense*
Lotus corniculatus	*Hieracium aurantiacum*
Ailanthus altissima	*Galinsoga ciliata*
Euphorbia Cyparissias	*Centaurea Jacea*
Lythrum Salicaria	*Centaurea maculosa*

In the *Flora* Torrey notes that *Raphanus Raphanistrum* has appeared on Long Island; *Melilotus alba* and *M. officinalis* he says are not common; *Trifolium agrarium* is found in "various places"; *Vicia tetrasperma* around New York City; *Echium vulgare* is said to be "rare," although locally a weed; *Rudbeckia hirta* has appeared in the State at Buffalo; and *Cirsium arvense* is spreading "southward."

Inspection of other early local floras shows much the same conditions prevailing. Wright and Hall (1836) list 111 introduced species out of a total of 940 from the vicinity of Troy and their list, with minor exceptions, agrees very well with Torrey's. Woodworth (1839, 1840) lists only about 30 nonindigenous species from the neighborhood of Kinderhook, but his list is no doubt incomplete in this respect. In 1840 (see Hoffmann, 1922, pp. 179–80 and Dewey, 1840) Dewey found *Rosa Eglanteria* well naturalized in Berkshire County, Mass.; *Cirsium arvense* had "already become a menace"; *Thymus Serpyllum,* which Torrey did not mention, was said to be "naturalized in a few places." The blackeyed Susan, *Rudbeckia hirta,* was not mentioned by Dewey.

A generation later than Torrey, when Hoysradt's (1875-79) flora of Pine Plains was published, several additional species were noted: *Amaranthus retroflexus, Silene Cucubalus, Lychnis alba* and *Euphorbia Cyparissias; Ailanthus* was "running wild," and *Rudbeckia hirta* was already "too common."

In recent years there have been several very conspicuous additions to our weed population, especially near the Hudson River. Since the coming of the New York Central Railroad, about the middle of the last century, numerous species have appeared along its right-of-way which are not found elsewhere. In the early days weeds were no doubt introduced in abundance around the various docks on the river where seagoing boats stopped. The "Stockport weed,"

Galium Mollugo, is said by old inhabitants to have been introduced in this way; in any event, it is now a very abundant and troublesome plant in fields in the clay soils between Stockport and Columbiaville. The "bird-foot trefoil," *Lotus corniculatus,* may have come in the same way. It is known in this country mostly as a ballast-plant, usually not well established. In the Hudson Valley, however, it has become a dominant feature of the roadsides and fields in many places, usually in clay. It is possible that it may eventually be of some value as a forage plant. A third species, the knapweed (*Centaurea Jacea*), has also become a pest on clay soils for several square miles around Columbiaville, while its relative (*C. maculosa*) is becoming very generally distributed along roadsides, where its pinkish purple flowers are conspicuous.

The purple loosestrife, *Lythrum Salicaria,* as noted above (text, p. 175) has become thoroughly at home in the marshes of the Hudson River and is rapidly spreading into adjacent territory. This immigrant from Europe seems to find optimum conditions in the river valleys of the eastern United States, as it is also widespread in the valley of the Delaware River, and in the Hoosic and Housatonic Valleys (Hoffmann, 1922, p. 304).

Other later arrivals in our area are the so-called "sulphury cinquefoil," *Potentilla recta,* which appeared in this country in the 1870's and is now becoming rather common; the hawkweeds, especially *Hieracium aurantiacum* and *H. pratense* which are often too abundant in poor pasture land; and finally the little garden weed, *Galinsoga ciliata,* which is adventive from the tropics and seems due to become thoroughly at home.

Table 26

Enumeration of Species by Families

Family	Species	Varieties	Forms
Lycopodiaceae	7		
Selaginellaceae	2		
Isoetaceae	3	1	
Equisetaceae	4		
Ophioglossaceae	5		1
Osmundaceae	3		
Dicksoniaceae	1		
Polypodiaceae	34		
Pinaceae	12		
Taxaceae	1		
Typhaceae	2		
Sparganiaceae	3		
Najadaceae	28		
Juncaginaceae	1		
Alismaceae	8		
Hydrocharitaceae	3		
Gramineae	109	8	
Cyperaceae	156	2	2
Araceae	8		
Lemnaceae	4		
Xyridaceae	2		
Eriocaulaceae	2		
Commelinaceae	1		
Pontederiaceae	3		

Table 26 (*Continued*)

Enumeration of Species by Families

Family	Species	Varieties	Forms
Juncaceae	18	1	
Liliaceae	30		
Amaryllidaceae	1		
Dioscoreaceae	1		
Iridaceae	3		
Orchidaceae	25		
Juglandaceae	7		
Myricaceae	3		
Salicaceae	23		
Betulaceae	12		
Fagaceae	11	1	
Urticaceae	10		
Loranthaceae	1		
Santalaceae	1		
Aristolochiaceae	1		
Polygonaceae	27		1
Chenopodiaceae	9		
Amaranthaceae	5		
Phytolaccaceae	1		
Illecebraceae	3		
Nyctaginaceae	1		
Aizoaceae	1		
Portulacaceae	3		
Caryophyllaceae	20		
Ceratophyllaceae	1		
Nymphaeaceae	5	1	
Magnoliaceae	2		
Ranunculaceae	31		
Berberidaceae	3		
Menispermaceae	1		
Lauraceae	2		
Papaveraceae	2		
Fumariaceae	4		
Cruciferae	26	1	
Capparidaceae	1		
Sarraceniaceae	1		
Droseraceae	2		
Crassulaceae	5		
Saxifragaceae	14		
Hamamelidaceae	2		
Platanaceae	1		
Rosaceae	65	1	
Leguminosae	39	1	
Geraniaceae	3		
Oxalidaceae	4		
Linaceae	2		
Balsaminaceae	2		
Limnanthaceae	1		
Rutaceae	1		
Simarubaceae	1		
Polygalaceae	5		
Euphorbiaceae	10		
Callitrichaceae	2		
Anacardiaceae	6		
Aquifoliaceae	3		
Celastraceae	1		
Staphyleaceae	1		
Aceraceae	7		
Rhamnaceae	3		
Vitaceae	5		
Tiliaceae	1		
Malvaceae	5		
Hypericaceae	8		
Elatinaceae	2		
Cistaceae	5		
Violaceae	18		
Cactaceae	1		
Thymelaeaceae	2		
Lythraceae	3		
Onagraceae	16		
Haloragidaceae	4		
Araliaceae	5		
Umbelliferae	20		
Cornaceae	8		
Ericaceae	32	2	
Primulaceae	7		
Oleaceae	5		
Gentianaceae	8		
Apocynaceae	3		
Asclepiadaceae	9		
Convolvulaceae	4		
Polemoniaceae	2		
Hydrophyllaceae	1		
Boraginaceae	8		
Verbenaceae	3		
Labiatae	29	1	
Solanaceae	8		
Scrophulariaceae	37	1	1
Lentibulariaceae	5		
Orobanchaceae	2		

TABLE 26 (*Concluded*)

Enumeration of Species by Families

Family	Species	Varieties	Forms
Phrymaceae	1		
Plantaginaceae	6		
Rubiaceae	18		
Caprifoliaceae	17		
Valerianaceae	3		
Dipsacaceae	1		
Cucurbitaceae	2		
Campanulaceae	6		
Lobeliaceae	6	1	1
Compositae	130	1	
Total	1,334	23	6

Grand total, including species, varieties and forms, 1,363.

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Appendix to

FLORA OF THE COLUMBIA COUNTY AREA NEW YORK

By

ROGERS McVAUGH
Temporary Botanist

NEW YORK STATE MUSEUM AND SCIENCE SERVICE
BULLETIN NUMBER 360 A

The University of the State of New York
The State Education Department

Albany, N. Y. April 1958

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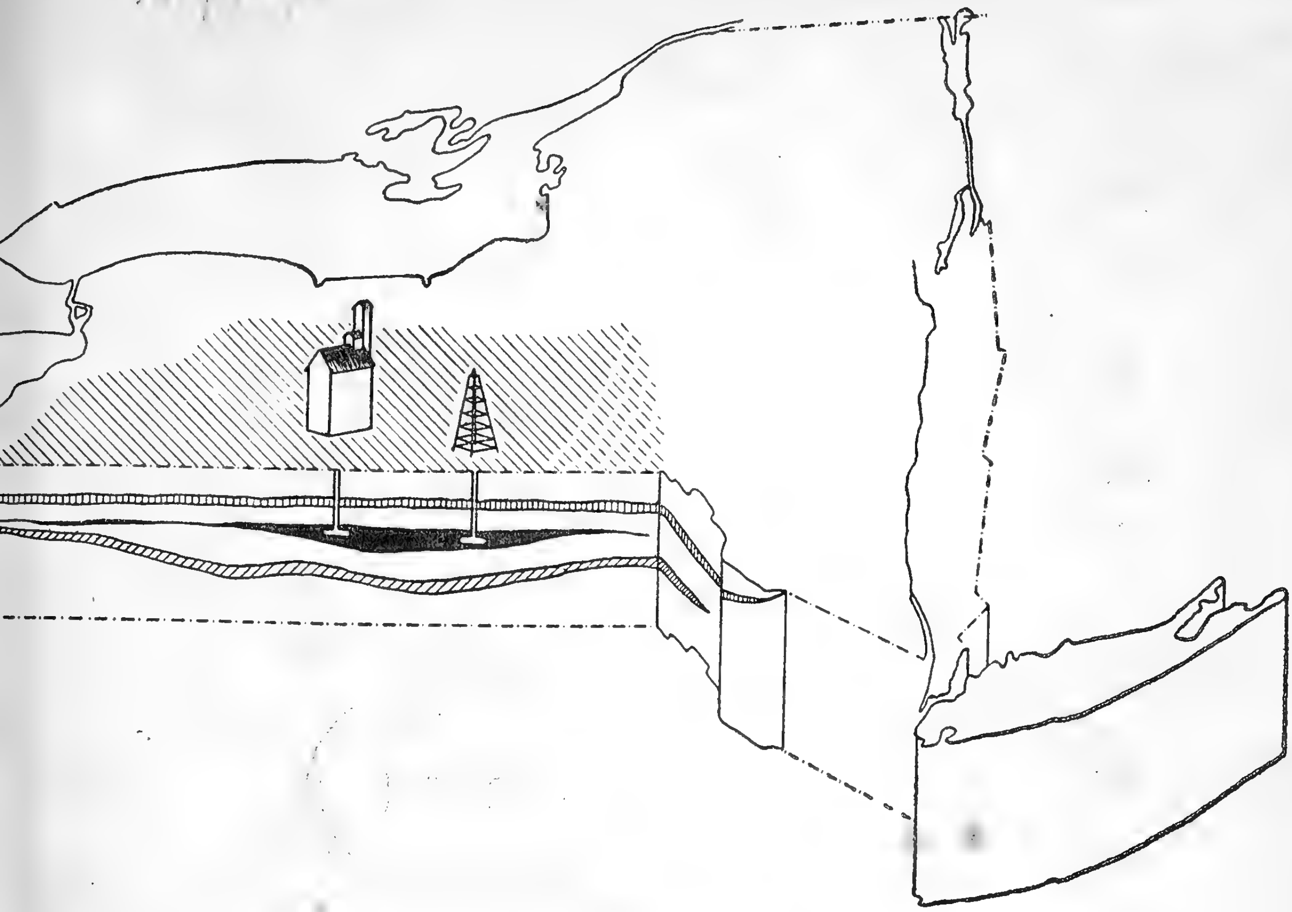

OCCURRENCE OF SILURIAN SALT IN NEW YORK STATE

By

William Lynn Kreidler

Senior Geologist

Geological Survey

New York State Museum and Science Service

NEW YORK STATE MUSEUM AND SCIENCE SERVICE

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OCCURRENCE OF SILURIAN SALT IN NEW YORK STATE*

By

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ABSTRACT

The first "salt making" in New York State dates back to 1661 but it was not until 1878 that rock salt was first discovered in New York. The rock salt, locally called the "Syracuse Salt," a lower member of the Camillus formation, occurs in the Upper Silurian (Cayugan Series) Salina group. Table II includes 161 well and mine records that were used to compile plates I and II. Plate I is believed to be sufficiently accurate to indicate the approximate depth at which the top of the salt zone will be encountered and to indicate the minimum and maximum thickness of the salt zone in the State. Plate II shows the stratigraphic position and thickness of the salt zone at the individual wells. It is estimated that 8,500 square miles of New York State are underlain by salt beds of potential commercial thickness.

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The author especially thanks Mr. James W. Wiggins for microscopic studies of the well cuttings of the Camillus formation in wells of Chautauqua and Delaware Counties and Mr. Nikos Thomaidis for the final drafting of plate I. Both men were formerly with the Wellsville office of the New York State Science Service.

INTRODUCTION

The first record of "salt making" in the present boundaries of New York dates back to 1661 when Dirck DeWolf, at Coney Island, was given the exclusive privilege granted by the authorities of Amsterdam, Holland, to make salt in the Dutch Colony of New Netherlands. However, the Onondaga field, near Syracuse, furnished the first permanent production of salt in New York State. Nathaniel Loomis extracted 500 to 600 bushels of salt in the fall of 1789 and winter of 1790. This salt was sold at $1 per bushel. This was the first time that salt was extracted for sale by white settlers in this area. For over 80 years the Onondaga salt springs were the main source of salt in New York. This field began to decline about 1887 because of competition from Michigan, Ohio and Virginia, and the long-established State interest in the Onondaga field was terminated in 1908.

Purpose. In the past five years oil and gas companies have become interested in the New York salt beds for underground storage of their products. This interest was stimulated by the closeness of this type of underground storage to New England and New York City markets. At present there are two companies storing L.P.G. (liquid petroleum gas) in salt beds of the State. They are the Suburban Propane Gas Corporation with underground storage in Cortland County, and the Anchor Petroleum Company with underground storage in Steuben County. Because of increased interest in the salt beds of New York for storage purposes a study was made to determine the eastern limits, depth and thickness of the salt zone in the State.

Source of data. The data upon which this study is based were obtained from driller's and geological records and the examination of well cuttings of wells drilled by the cable tool method for gas or salt in western and central New York. The salt mine records are based on geological logs in the Survey files. Over 300 records were examined but only 161 well and mine records were selected for this report. Table II lists the well and mine records used in this study with a skeletal log of each record. These are located by county and map numbers. The corresponding county and map numbers are shown on plate I.

Location. Past exploration for salt and gas below the Oriskany (Lower Devonian) horizon indicates that almost all of central and western New York is underlain by beds of rock salt. On plate I the western extent of the salt zone is shown by a heavy dashed line

which passes through the following counties: Chautauqua, Cattaraugus, Erie, Wyoming and Genesee. Salt beds are believed to occur as far east as western Chenango or Broome Counties as salt beds are known to be present in Cortland and Madison Counties. The salt zone extends south of the outcrop belt of the Salina Group (see plate I) and underlies the Devonian beds of New York and enters Pennsylvania. It is estimated that 8,500 square miles of New York State are underlain by salt beds of potential commercial thickness.

Wells. On June 20, 1878, rock salt was first discovered in New York State in Wyoming County. The discovery well, known as the Pioneer well, was drilled by the Vacuum Oil Company on the farm of C. B. Mathews, one mile south of the village of Wyoming. In the next 12 to 15 years numerous salt wells were drilled and salt plants were erected in Genesee, Livingston, Ontario and Wyoming Counties. The salt was extracted from the salt beds by pumping fresh water into the wells and repumping the brine to the surface. Crystalline salt was recovered by evaporation of the brine in one of the following methods: (*a*) in shallow troughs by the sun's rays; (*b*) heating in long shallow open pans or kettles; (*c*) use of steam with jacketed kettles or grainers; (*d*) evaporation by steam in vacuum pans. The salt industry reached its peak in 1893, but afterward overproduction and competition forced many of the salt companies to shut down. It was not until about 1907 that the salt industry in the State was once again on a firm business basis.

Mines. Of the six salt mines on which shafts have been sunk in New York State, five were in operation before 1908. Four of these mines were located in Livingston County and one in Genesee County. The Retsof salt mine was the first in New York. The 12-by 16-ft shaft was started September 21, 1884, on the Joseph D. Lewis farm in Livingston County and on September 10, 1885, salt was found at a depth of 995 feet. The present shaft used by the Retsof mine was started July 6, 1921. This is the Fuller shaft and is about one-half mile south of the original Retsof mine shaft.

The five other salt mines completed their shafts in the following chronological order: the Lehigh salt shaft (1892) in Genesee County; the Livonia salt shaft (August 13, 1892) in Livingston County; the Greigsville salt shaft (October 1892) in Livingston County; the Sterling salt shaft (1907) in Livingston County; the Rock salt shaft (1917) in Tompkins County.

In 1895, the Retsof Mining Company obtained control of the Lehigh Salt Company, the Livonia Salt Company and the Greigs-

ville Salt Company. This consolidation is known as the Retsof Mining Company. It was necessary to close the other mines because of overproduction and the low price of salt. In 1930, the Retsof Mining Company, a subsidiary of International Salt Company, obtained control of the Sterling Salt Company.

The two salt mines that now operate in New York State are the Retsof Mining Company at Retsof and the Cayuga Rock Salt Company, Inc., at Myers. The latter company acquired the Rock Salt Corporation assets in Tompkins County.

Difficulties of sample interpretation when using cable tool well cuttings:

1. Samples of the well cuttings are taken only when the well is bailed. This sample interval ranges from 3 to 10 feet depending on the hardness or softness of the rock beds being drilled. For example, if the bed is dolomite, sampling may range from 2 to 4 feet. In contrast, in a softer bed, as salt, the sampling ranges from 6 to 10 feet.

2. Some of the well records did not indicate the presence of salt within the area of salt deposition in New York. These records were eliminated. It is probable that salt was not recorded in these wells because: (*a*) salt beds are interbedded with shales, dolomites and anhydrites; (*b*) salt will go into solution if a well is drilled with fresh water so that only a few salt crystals show in the cuttings with the remainder of the sample consisting of shale, dolomite or anhydrite; (*c*) salt may become mixed with drilling mud and not be noticed in the well cuttings; (*d*) of contamination of the well cuttings by cavings of Salina type rocks from above into an open or uncased hole; (*e*) well samples may not have been examined before being washed.

An experienced driller can usually tell by the ease of drilling that he has entered a salt bed. Some drillers would record individual salt beds, whereas others would record the top of the uppermost salt bed, or when the first mixture of salt and shale was encountered, and they would record the base of the lowest salt bed or when the drill passed through the last mixture of salt and shale. This section, which contains beds of salt, shale, dolomite and anhydrite, is logged as salt. Due to the different methods of recording the salt section it was thought best to contour the top of the salt zone and thickness of the salt zone with individual beds of rock salt listed for the wells in table II.

STRATIGRAPHY

The salt, locally called the "Syracuse Salt," occurs in the Upper Silurian (Cayugan Series) Salina group. The Salina group is post-Lockport—Guelph and pre-Onondaga in western New York and post-Lockport and pre-Helderberg in central and east-central New York. The Cobleskill formation is commonly omitted from the Salina group but for convenience it is included as an upper formation. Rickard (1955, p. 1608) regards the Manlius and Rondout formations as Helderbergian. The formations underlying the Cobleskill and making up the rest of the Salina group are from top to bottom: Bertie, Camillus and Vernon. The Syracuse salt member, consisting of beds of rock salt with interbedded shale, dolomite and anhydrite, forms the lower member of the Camillus formation. The individual salt beds vary from 15 inches to 548 feet. In this discussion, the Syracuse salt member is referred to as the "salt zone."

The Salina group crops out in New York in an east-west belt about 13 miles south of Lake Ontario and averages 10 miles in width from the Niagara River east through Madison County. No beds of rock salt are found in the exposed Salina strata because the salt has been leached out by groundwater. South of the outcrop the Salina is overlain by Devonian formations. The regional dip of the surface-beds is slightly west of south at a rate of 30 feet to 50 feet per mile.

Plate II shows that the interval in feet between the tops of key horizons varies from east to west along lines A-A′ and B-B′. Table I shows that the Tully-Onondaga and Onondaga-Lockport intervals change in individual wells on line B-B′.

TABLE I

WELLS FROM EAST TO WEST	INTERVAL IN FEET FROM TOP OF TULLY TO TOP OF ONONDAGA	INTERVAL IN FEET FROM TOP OF ONONDAGA TO TOP OF LOCKPORT
M. Hazlett No. 1.........	1,880?	814
E. C. Kesselring No. 1....	1,348	2,686
Federal Land Bank No. 1.	1,089	2,676
H. Harrington No. 1......	767	2,356
L. Newton No. 1.........	536	1,330
H. Hotchkiss No. 1.......	Tully Absent	790
C. R. Reed No. 1.........	Tully Absent	615

The westward decreasing Tully-Onondaga interval cannot be traced in the subsurface west of Allegany County. The limestone formerly regarded as Tully by the drillers in Cattaraugus and Chautauqua Counties has been misidentified and is probably either the Genundewa, Tichenor or other limestone of the Hamilton Group. The most westerly exposure of the Tully is about one mile north of Rushville and east of Canandaigua Lake but in the subsurface the Tully occurs in Allegany County.

STRUCTURAL GEOLOGY

The salt zone of New York is in the northern part of the Allegheny synclinorium. Structurally, the Allegheny synclinorium is broad and asymmetrical and the long axis trends in a northeasterly direction with the steeper limb on the southeast. In Pennsylvania there are rather prominent anticlinal and synclinal folds with axes trending approximately parallel to the long axis of the synclinorium. The folds become less pronounced in New York and gradually decrease to the northwest, so that they are hardly perceptible in northern Allegany, Steuben and Schuyler Counties.

In drilling for Oriskany gas in Allegany and Steuben Counties, wells have proved the existence of anticlines, synclines and faults. The domes along the anticlinal trends are complicated by faults which parallel the axial trends and in places cross these trends. Displacement by faulting seems to be greatest at depth and gradually decreases nearer the surface, probably because the soft shales of the Hamilton group absorbed the effects of faulting. This faulting may be indicated on the surface by a slight displacement or by a gentle fold and probably occurred during late Paleozoic mountain building. The faults are believed to intersect the salt zone but have been omitted from the map and profiles because of lack of control owing to wide spacing of wells drilled to or through the salt zone. Lack of evidence also does not allow projection of the anticlinal and synclinal trends in the area covered by the salt map (plate I). Plate I is, therefore, not a true structure map but is only an approximate structural contour and isopach map of the salt zone.

DISCUSSION OF MAP OF SILURIAN SALT ZONE (PLATE I)

Sea level is the datum used. The top of the salt zone does not necessarily mean the first bed of rock salt but may indicate where the first "vein" of salt or mixture of salt and shale is present in the shales. The first commercial bed of rock salt may be 50 feet to 100 feet below the mixture of salt and shale. The base of the salt zone was picked where the last evidence of salt and shale mixture was found. The salt beds are apparently local lenses that are not continuous over the whole area and interfinger laterally with the shales, dolomites and anhydrites. In contouring the top of the salt zone a 500-foot interval was chosen because of the wide spacing of the wells. In the northwest area more wells gave better control and so a 100-foot contour interval was chosen.

The isopachs of the salt zone are shown in red on plate I whereas the subsurface contouring of the top of the salt zone is in black.

It is believed that the map (plate I) is sufficiently accurate to permit a rough approximation of the depth at which the top of the salt zone can be expected and to indicate the minimum and maximum thickness of the salt zone. The greatest discrepancy will be found in the anticlinal and synclinal area in southern Allegany and Steuben Counties.

DISCUSSION OF STRATIGRAPHIC SECTION (PLATE II)

The stratigraphic sections (plate II) shows the difference in elevation of the key beds at the individual wells in respect to a sea level datum plane. The locations of the stratigraphic section lines, each of which begin and end with a well, are shown on plate I.

The two west-east lines are A-A′ and B-B′. On line A-A′, a dip of 30 feet per mile was assumed from the H. Jones well in Erie County to the Nunda well in Livingston County. At the Gruschow No. 1 well in Livingston County and wells to the east that were projected to line A-A′ the dip was increased to 40 feet per mile. On line B-B′, a dip of 40 feet per mile was assumed from the Kyle Morse No. 1 well in Chautauqua County to the E. Collins No. 1 well in Steuben County. At the Federal Land Bank No. 1 well in Schuyler County and wells to the east that were projected to the line B-B′ the dip was increased to 50 feet per mile.

The well records selected for the above west-east sections that do not fall on line A-A′ or B-B′ are connected by a line drawn normal (90°) to the section line from the well (see plate I). The proper regional dip was used to bring such wells with their key beds to a corrected elevation on lines A-A′ or B-B′.

The two north-south lines are C-C′ and D-D′. Dr. H. L. Alling has called the writer's attention to the fact that on line C-C′, in the area of the Retsof mine, a more accurate thickness of the salt zone can be derived by combining the Sterling diamond drill core and the Fuller Shaft core. The two cores can be matched by correlating the base of the 18 foot salt bed at 1,074 feet in the Fuller Shaft with the Sterling mine floor at 500.2 feet below sea level. The two core records overlap and the correlation is fairly satisfactory. Therefore, on C-C′ line the thickness of the salt zone in the Retsof mine will be more than recorded by the Fuller Shaft record in table II.

The well records selected for the north-south sections that do not fall on the line are projected in the direction of the regional strike, a little south of east, to the point at which they intersect the section line (see plate I).

Table II

WELL AND MINE RECORDS UTILIZED

NEW YORK:

PENNSYLVANIA:

Table II A

WELL AND MINE RECORDS OF NEW YORK

ALLEGANY COUNTY

Quadrangle		Angelica	Canaseraga	Franklinville	Angelica
Map Number		1	2	3	4
Name of Well		Bank of Angelica #3		T. J. & M. Williams	Matt Connor #1
Operator		Kaufman, Gordon, et al.		Iroquois Gas Corp.	Filmer Oil & Gas—B.Q.D.C.
Township		Allen	Burns	Centerville	Hume
Latitude		8,400′ South of 42°25′		11,700′ North of 42°25′	11,100′ South of 42°30′
Longitude		3,800′ West of 78°00′		8,400′ West of 78°15′	19,250′ West of 78°05′
Date Completed		6/12/37	1909	9/14/31	1/25/30
Elevation		2,003′	1,250′+−	1,927′	1,530′
Tully		2,742′–			2,059′–2,075′
Onondaga		3,260′–3,376′		3,006′–3,130′	2,456′–2,602′
Oriskany		3,376′–3,384′			No Oriskany
Salt Zone		3,669′–3,875′	3,050′–3,115′	3,625′–3,742′	2,917′–3,200′
Lockport		4,415′–	Not reached	3,890′–4,236′	3,350′–3,550′
Medinan	Red Medina (Grimsby)	4,809′–4,932′		4,251′–4,331′	3,736′–3,835′
	White Medina (Whirlpool)			4,331′–4,337′	3,841′–3,846′
Deepest FM		Queenston	U. Silurian	Queenston	?
Total Depth		5,001′	3,200′	4,388′	5,084′
Remarks		Salt beds 3,669′–3686′, 3,814′–3,860′ Medina dry tight sand. 50 Mcf. of gas-abandoned.	Salt beds 3,050′–3,115′ A little gas and oil at 975′. Bottomed in blue shale. Location at Canaseraga.	Salt beds 3,625′–3,648′, 3,690′–3,742′. Show of gas at 2,390′. Well abandoned.	Salt beds 2,917′–2,977′ Oil show at 744′–762′ 912′–930′. Oil and gas at 1,186′. Well abandoned.

Abbreviations Used in Well Records:

Cf.—Cubic feet Mcf.—1,000 cubic feet I.O.F.—Initial open flow I.R.P.—Initial rock pressure

* Set of samples on file in Survey Office at Albany, N. Y.

*P—partial set of samples on file in Survey Office at Albany, N. Y.

(*) Geological or sample analysis on file in Survey Office at Albany, N. Y.

(*P) Partial geological log or sample analysis on file in Survey Office at Albany, N. Y.

TABLE II A—Continued

ALLEGANY COUNTY			BROOME COUNTY	
WELLSVILLE	BELMONT	BELMONT	BINGHAMTON	GREENE
5	6	7	1	2
Adelbert King #1	F. Chadwick #1	L. Newton #1	Brown #1	Harry Pease #1
Ravening, et al.	B. Q. D. C. & W. E. Sawyer	Cady, et al.	East Penn Oil & Gas Co.	Central N. Y. Gas Corp.
Wellsville	Wirt	Wirt	Binghamton	Lisle
11,600′ South of 42°10′	25,950′ South of 42°10′	8,500′ South of 42°10′	4,200′ North of 42°05′	10,000′ North of 42°20′
7,800′ East of 78°00′	1,650′ West of 78°10′	1,850′ West of 78°05′	8,550′ East of 75°55′	2,150′ East of 76°00′
4/28/50	2/25/29	12/18/29	1888	5/23/34
1,479′	1,860′	1,917′	940′+	1,300′
3,366′–3,419′	3,850′–3,882′	3,766′–3,808′	2,250′–2,300′?	1,505′–
3,925′–3,971′	4,347′–4,433′	4,302′–4,390′	3,915′ Est.–	3,081′–3,160′
3,971′–4,021′	4,433′–4,438′	4,390′–4,395′	Not reached	Not present
4,326′–4,636′	4,740′–4,811′	4,794′–4,898′	Not reached	Not reached
Not reached	Not reached	5,632′–5,880′		
		5,890′–		
		–5,995′		
Camillus	Camillus	Queenston	M. Devonian	U. Silurian
5,025′	4,850′	6,500′	3,117′	3,250′
Salt beds 4,326′–4,359′? 4,389′–4,455′? 4,522′–4,530′ 4,582′–4,589′ 4,605′–4,613′ 4,625′–4,636′ Show of gas at 3,973′, then salt water—abandoned. *(*)	Salt beds 4,740′–4,745′ 4,755′–4,811′ Three gas pockets in Onondaga. Plugged back to Richburg sand.	Salt beds 4,794′–4,800′ 4,865′–4,898′ Show of gas at 620′. Richburg sand 905′–1,170′. Waugh Porter 1,241′–1,276′. Well abandoned.	Completed in Hamilton beds. Dry hole.	No Oriskany sand. Dry hole.

TABLE II A—Continued

	BROOME COUNTY		CATTARAUGUS COUNTY	
QUADRANGLE	APALACHIN	APALACHIN	CHERRY CREEK	CHERRY CREEK
Map Number	3	4	1	2
Name of Well	R. G. Hotchkiss #1	Chase-Troy Chem. Co. #1	William Hills #1	C. J. Sutter #1
Operator	Lamphere, et al.	Nat'l. Dr'l'g. & Dev'l. Co.	Hanley & Bird	Hanley & Bird
Township	Maine	Vestal	Dayton	Dayton
Latitude	100' South of 42°10'	3,300' North of 42° 10'	10,200' South 42°25'	10,800' South of 42°25'
Longitude	2,000' East of 76°05'	6,750' West of 76°00'	1,300' West of 79°00'	10,800' West of 79°00'
Date Completed	10/27/49	8/ /33	12/5/40	4/8/41
Elevation	968'	830'	1,295'	1,415'
Tully	2,006'–2,054'	Not reported		
Onondaga	3,722'–3,810'	4,142'–4,292'	–2,201'	2,035'–
Oriskany	3,810'–3,828'	4,292'–4,319'	No record	No record
Salt Zone	Not reached	Not reached	2,619'–2,650'	2,678'–2,732'
Lockport			2,810' Est. –2,984'	2,814'–3,046'
MEDINAN: Red Medina (Grimsby)			3,116'–3,198'	3,182'–3,264'
MEDINAN: White Medina (Whirlpool)			3,208'–3,227'	3,279'–3,300'
Deepest FM	U. Silurian	Helderbergian	Queenston	Queenston
Total Depth	3,850'	4,412'	3,326'	3,303'
Remarks	Plugged and abandoned. Dry hole. *	15' of Oriskany porous dry sand. Dry hole.	Salt beds 2,619'–2,650'. Show of gas at 900' and 968'. Black water at 2,842'. Dry and abandoned hole.	Salt beds 2,678'–2,707'. Show of gas at 3,284' and 3,289'. Dry and abandoned hole.

TABLE II A—Continued

CATTARAUGUS COUNTY

FRANKLINVILLE	SALAMANCA	CHERRY CREEK	CATTARAUGUS	CATTARAUGUS
3	4	5	6	7
Clara Howard #1	Aultman-Hale #1	William Marsh #1	C. H. Richey #1	J. P. Strickland #3
	B. Q. D. C. and Hanley & Bird	B. Q. D. Corp.	Deep Rock Drilling Co.	New Penn Dev. Co.
Franklinville	Humphrey	Leon	New Albion	Otto
1,550′ North of 42°20′	5,100′ North of 42°10′	11,400′ North of 42°15′	4,300′ North of 42°20′	10,250′ South of 42°25′
8,525′ East of 78°30′	9,500′ West of 78°30′	7,000′ West of 79°00′	1,400′ East of 78°55′	3,675′ East of 78°55′
1908	10/1/30	11/15/36	6/25/34	10/24/40
1,625′	1,942′	1,367′	1,821′	1,155′
2,912′–	3,790′–3,923′	2,324′–2,440′	2,710′–	1,932′–
No record	Not present	Not present	Horizon 2,800′	Not present
3,370′–3,637′	4,379′–4,535′	3,000′–3,040′	3,330′–3,350′	2,543′–2,568′
3,717′–	4,697′–4,945′	3,094′–3,416′	3,520′–	2,568′?–
4,475 Est.–	5,071′–5,119′	3,482′–3,588′	3,842′–3,889′	3,009′–
	5,119′–5,178′	3,597′–3,614′	3,900′–3,930′	3,135′–3,144′
Clinton	Queenston	Queenston	Queenston	Queenston
4,448′+–	5,307′	3,620′	3,967′	3,175′
Salt beds 3,370′–3,384′ 3,536′–3,559′ 3,584′–3,592′ 3,606′–3,615′ 3,626′–3,637′. Sulphur water at 3,850′. Dry and abandoned hole.	Salt beds 4,460′–4,465′. No Oriskany sand.	Salt bed 3,000′–3,040′. Gas at 1,270′. Black water at 3,265′. 98 Mcf. gas in Medina.	Salt bed 3,330′–3,350′. Black water at 3,567′. Salt water at 3,668′. No gas. Fault well.	Mixed salt 2,543′–2,568′. 40 Mcf. of gas at 3,139′.

TABLE II A—Continued

	CATTARAUGUS COUNTY			CAYUGA COUNTY
QUADRANGLE	CHERRY CREEK	RANDOLPH	RANDOLPH	AUBURN
Map Number	8	9	10	1
Name of Well	C. L. Oldham #1	H. Hotchkiss #1	J. W. Sharp #1	Aurora Well
Operator	Penn York Nat. Gas Corp.	Arkansas Fuel Oil Co.	H. Brunt, et al.	E. B. Alvord
Township	Perrysburg	Randolph	Red House	Ledyard
Latitude	1,650′ South of 42°30′	9,600′ North of 42°05′	11,500′ North of 42°05′	1,250′ North of 42°45′
Longitude	6,000′ East of 79°05′	6,200′ East of 79°00′	7,200′ West of 78°45′	10,200′ West of 76°40′
Date Completed	1940	1924	Completed 1949. Deepened 1954.	Before 1886
Elevation	980′	1,764′	1,439′	400′
Tully				
Onondaga	1,373′–	3,390′–	3,220′–3,347′	500′–675′
Oriskany	Not present	Not present	Horizon 3,347′–3,349′	No record
Salt Zone	Not present	3,880′–4,105′	3,679′–3,995′	938′–998′
Lockport	2,017′–	4,180′–4,455′	4,177′–4,345′	Not reached
MEDINAN: Red Medina (Grimsby)	2,314′–2,401′	4,595′–	4,503′–	
MEDINAN: White Medina (Whirlpool)	2,417′–2,439′		4,608′–4,615′	
Deepest FM	Queenston	Red Medina	Queenston	U. Silurian
Total Depth	2,448′	4,684′	4,677′	1,068′
Remarks	No salt.	Salt beds 3,880′–3,884′ 4,030′–4,105′. 320 Mcf. of gas in R. Medina. Show of oil at 668′. Drilled 89′ of Medinan.	Salt beds 3,679′–3,720′ 3,878′–3,889′, 3,922′–3,933′, 3,945′–3,995′, Oriskany dry. No black water in Lockport 20 Mcf. of gas at 4,562′. Deepened in 1954. *	Salt+shales 938′–998′ No gas recorded. Well was drilled deeper at a later date in search of salt. None found.

Table II A—Continued

CAYUGA COUNTY	CHAUTAUQUA COUNTY			
Genoa	Dunkirk	Dunkirk	Chautauqua	Cherry Creek
2	1	2	3	4
J. C. Mahaney	Johnson #1	Vellone	A. Donelson #1	C. M. Estee
Reserve Oil Corp.	Republic	Republic	T. M. Pettigrew	Wyoga-Schrack
Ledyard	Arkwright	Arkwright	Busti	Charlotte
6,600′ North of 42°40′	3,500′ South of 42°25′	6,200′ North of 42°25′	8,350′ North of 42°00′	12,200′ South of 42°20′
6,000′ East of 76°40′	4,050′ West of 79°15′	3,800′ West of 79°15′	1,300′ West of 79°15′	5,300′ West of 79°10′
7/3/31	1940		8/8/47	1/13/36
824′	1,450′	1,240′	1,521′	2,040′
17′–35′				
1,010′–1,065′	1,924′–	1,583′–1,840′	3,163′–3,313′	2,785′–3,025′
1,065′–1,100′	Not present	No record	Horizon 3,313′–3,331′	Horizon 3,025′–3,029′
1,503′–2,247′	No salt	No salt	No salt	3,420′–3,450′
2,685′–	2,580′–	2,210′–2,460′	No record	3,450′–3,855′
–3,091′	2,887′–	2,602′–2,677′		3,875′–3,969′
3,099′–	3,034′–3,049′	2,737′–2,750′		3,969′–3,988′
Cambrian	Queenston	Queenston	Lockport	Queenston
6,166′	3,061′	2,771′	4,150′	4,030′
Salt beds 1,617′–1,632′ 1,674′–1,730′. Salt water in Oriskany. *	Dry hole.	Gas at 2,622′–2,634′ 2,684′–2,688′. I.O.F. 5,200 Mcf.	Black water at 4,114′. Plugged & abandoned.	Salt bed 3,420′–3,450′. Gas pockets and shows at 397′, 417′ & 3,685′. Gas show at 3,025′–3,029′ and show in Red Medina.

TABLE II A—Continued

CHAUTAUQUA COUNTY

QUADRANGLE		JAMESTOWN	CLYMER	CHAUTAUQUA	CHAUTAUQUA
Map Number		5	6	7	8
Name of Well		Weiss #1	O. R. Reed #1	Kyle Morse #1	Gerry Homes #1
Operator		Jansen, Ross et al.	Whitmer Co.	E. M. Glaros N. Katras	Guy Neeley
Township		Kiantone	French Creek	Harmony	Gerry
Latitude		7,000′ North of 42°00′	8,900′ South of 42°05′	5,500′ South of 42°05′	11,000′ North of 42°10′
Longitude		750′ West of 79°10′	3,700′ West of 79°40′	300′ East of 79°25′	200′ West of 79°15′
Date Completed		1932	1932		9/1/54
Elevation		1,244′	1,682′	1,572′	1,340′
Tully					
Onondaga		2,999′–3,156′	2,861′–3,046′	2,904′–3,100′	2,407′–2,624′
Oriskany		Horizon 3,156′–3,168′	Horizon 3,046′–3,113′	Horizon 3,100′–3,127′	No sand
Salt Zone		3,508′–3,738′	No Salt	3,540′–3,655′	No Salt
Lockport		3,885′–4,040′	3,476′–3,728′	3,680′–	3,284′ –
MEDINAN	Red Medina (Grimsby)	4,194′–4,234′	3,946′–3,989′	4,058′–4,082′	3,550′–
	White Medina (Whirlpool)	4,237′–4,249′	4,026′–4,069′	4,245′–4,254′	3,669′–3,678′
Deepest FM		Ordovician	Queenston	Little Falls Dol.	Queenston
Total Depth		4,700′	4,087′	7,100′	3,751′
Remarks		Salt beds 3,508′–3,520′, 3,525′–3,533′, 3,719′–3,738′. Gas at 735′, 1,072′. Oil ss. 2,011′–2,066′. Salt Water at 3,448′. No gas in Medina.	No salt beds Show of oil at 2,560′. Show of gas at 3,092′, 3,754′, & 3,972′. Water at 3,348′–3,744′ and 3,792′.	Salt & shales 3,540′–3,655′. Black water at 3,840′. Gas at 4,062′–4,065′, 4,250′–4,254′, & 6,880′. Salt Water at 7,100′. Top of Trenton 6,124′. Preparing to hydrafrac. *	No salt. Black water at 3,291′. Gas 1,600 Mcf. in Medina I.R.P. 500 #. *

Table II A—Continued

CHEMUNG COUNTY				CHENANGO COUNTY
Elmira	Waverly			New Berlin
1	2			1
J. Murphy #1	E. C. Kesselring #1			C. C. Lobdell #1
Lycoming	N. Y. S. Nat. Gas Corp.			Bradley Prod. N. Y. S. N. G. Co. & Quaker State
Elmira	Van Etten			Columbus
4,100′ North of 42°05′	11,600′ North of 42°10′			9,700′ North of 42°40′
6,700′ West of 76°45′	10,300′ West of 76°30′			3,150′ West of 75°21′
5/25/31	5/6/53			11/12/49
1,283′	1,077′			1,373′
1,890′–	1,626′–1,712′			Not present
3,110′–3,170′	2,974′–3,033′			1,455′–1,540′
3,170′–3,203′	3,033′–3,104′			Horizon 1,540′–1,567′
3,922′–3,934′	3,683′–4,927′			No salt
Not reached	5,660′–5,940′			2,610′–2,678′
	6,380′–6,540′			Absent
	6,539′–6,652′			Absent
U. Silurian	Theresa			Pre-Cambrian
3,950′	11,145′			5,701′
Salt bed 3,922′–3,934′. Puff of gas in Onondaga. Oriskany is tight & dry.	Salt beds 3,683′–3,745′, 3,790′–3,805′, 3,830′–3,890′, 3,903′–4,000′, 4,126′–4,180′, 4,203′–4,282′, 4,284′–4,400′, 4,807′–4,815′, 4,854′–4,870′. *	Gas shows: 3,036′, 6,592′, 8,800′, 8,888′, 8,972′ & 9,187′. Salt water: 3,090′, 7,180′, 11,118′ & large volume at 11,145′.	Bald Eagle-Oswego interval 7,392′–8,067′. Trenton-Black River interval 8,902′–9,756′.	Oneida 3,040′–3,075′. Top of Trenton 4,276′–4,710′. Top of Cambrian 5,216′. Top of Pre-Cambrian 5,534′–5,701′+. *

TABLE II A—Continued

	CHENANGO COUNTY	CORTLAND COUNTY		DELAWARE COUNTY
QUADRANGLE	NORWICH	HARFORD	HARFORD	ONEONTA
Map Number	2	1	2	1
Name of Well	Norwich well #1	P. Overbaugh #1	Surburban #2	M. Hazlett #1
Operator	A. W. McQueen	Surburban Propane Gas Co.	Suburban Propane Gas Co.	E. S. Warner et al.
Township	Norwich	Harford	Harford	Franklin
Latitude	1,850′ North of 42°30′	2,000′ North of 42°25′	1,500′ North of 42°25′	3,300′ North of 42°20′
Longitude	10,850′ West of 75°30′	9,400′ West of 76°10′	10,000′ West of 76°10′	400′ East of 75°05′
Date Completed	1888	6/18/52	10/12/54	1/30/33
Elevation	1,100′	1,177′	1,165′	1,457′
Tully	No record	1,036′–1,073′	1,053′–	1,750′?–1,811′?
Onondaga	Not reached	2,506′–2,586′	2,490′–2,572′	3,638′–3,734′
Oriskany		Horizon 2,586′–2,588′	Horizon 2,572′–2,576′	3,824′–3,846′
Salt Zone		3,063′–3,218′+	3,040′–3,289′+	No salt
Lockport		Not reached	Not reached	4,452′–4,557′
MEDINAN: Red Medina (Grimsby)				
MEDINAN: White Medina (Whirlpool)				
Deepest FM	Chittenango?	Camillus	Camillus	Above Clinton
Total Depth	2,334′	3,218′	3,305′	4,570′
Remarks	Hamilton has a probable thickness of from 1,615′ to 1,785′. Pockets of gas at 384′ & 875′ down to 1,200′.	Salt beds 3,070.7′–3,079′, 3,081.4′–3,091′, 3,093.1′–3,123′, 3,125.4′–3,132′, 3,136′–3,144.3′, 3,154′–3,180′, 3,204.4′–3,218′. Storage of propane in salt beds. Dry. *	Storage of propane in salt beds. Dry.	Show of gas in Oriskany and Vernon. *

Table II A—Continued

ERIE COUNTY

Springville	Eden	Ellicottville	Arcade	Depew
1	2	3	4	5
Henry Jones	Well #796	Springville Well	Fred Howe	F. W. Heist #1
	Iroquois Gas Corp.			Reserve Gas Company
Concord	Concord	Concord	Sardinia	Alden
1,350′ North of 42°35′	2,850′ North of 42°35′	2,200′ South of 42°30′	13,800′ South of 42°35′	7,200′ North of 42°55′
9,400′ West of 78°40′	1,100′ West of 78°45′	5,700′ West of 78°40′	8,100′ East of 78°30′	10,400′ West of 78°30′
1878–1879	1925			10/12/49
1,055′	1,560′	1,300′	1,447′	
1,225′–	1,810′–1,970′	1,800′–	2,000′–2,171′	49′–177′
No record	Absent	No record	No record	No record
1,800′–	Absent	2,525′–2,550′+	2,575′–2,615′	No record
No record	2,466′–2,661′	Not reached	2,765′–2,970′	639′–957′
	2,782′–2,824′		3,118′–3,123′	983′–1,056′
	2,880′–2,890′			1,056′–1,098′
Silurian	Queenston	Camillus	Queenston	Queenston
2,140′	2,908′	2,550′	3,258′	1,117′
Salt 60′ to 80′ thick. Black sulphur water at 2,008′. Known as "The Old Boston Well."	Shows of gas at 531′, 540′, 670′, 1,997′ and 2,524′. Show of gas at 1,977′. Show of salt water at 1,992′, 2,531′ and 2,884′.	Salt bed 2,525′–2,550′.	Salt bed 2,575′–2,615′. No gas and dry in Red Medina.	Shows of gas at 1,050′–1,053′, 1,087′–1,092′. I.O.F. 17,900 cu. ft. increased to 28,000 after shooting. Now called Gilbert #1.

Table II A—Continued

	Erie County		Genesee County	
Quadrangle	Springville	Depew	Batavia	Batavia
Map Number	6	7	1	2
Name of Well		B. Feldman #1		G. H. Beaver #1
Operator		R. S. Knapp		Alden-Batavia Gas Co.
Township	Holland	Newstead	Batavia	Bethany
Latitude	300′ North of 42°40′	12,600′ South of 43°00′	3,500′ South of 43°00′	8,750′ South of 42°55′
Longitude	1,700′ West of 78°30′	4,100′ West of 78°30′	6,050′ West of 78°10′	3,600′ West of 78°10′
Date Completed		12/1/48	1887	1915
Elevation	1,252′	805′	889′	1,150′
Tully				
Onondaga	1,322′–1,488′	29′–143′	100′–250′	545′–690′
Oriskany	No record	No record		
Salt Zone	No salt	No salt	600′–601′.3″	1,107′–1127′
Lockport	2,047′–2,257′	603′–815′	750′–1,000′	1,285′–1,455′
Medinan: Red Medina (Grimsby)	2,371′–2,467′	922′–1,003′	Poor record	1,636′–1,764′
Medinan: White Medina (Whirlpool)		1,003′–1,042′	Poor record	
Deepest FM	Silurian	Queenston	?	Silurian
Total Depth	2,482′	1,067′	2,000′	1,772′
Remarks		65 Mcf. of gas in Medina I.R.P. 385 lb.	15″ of salt at 600′.	Salt bed 1,107′–1,127′. 120′ of dry sand in Medina. Good shows of gas and water in Onondaga.

Table II A—Continued

GENESEE COUNTY

Batavia	Batavia	Attica	Batavia	Caledonia
3	4	5	6	7
A. Partridge #1	A. Partridge #2	Charles Chick	Lehigh salt shaft	W. J. Cook #1
	Alden-Batavia Gas Co.		Lehigh Salt Mine Company	
Bethany	Bethany	Darien	LeRoy	Pavilion
11,000′ South of 42°55′	10,900′ South of 42°55′	14,800′ South of 42°50′	12,550′ North of 42°55′	6,950′ North of 42°55′
2,025′ East of 78°05′	1,500′ West of 78°05′	1,150′ East of 78°20′	3,550′ West of 78°00′	7,100′ East of 78°00′
	1916		1892	1925
1,110′	1,300′	1,220′	918′	910′
570′–720′	710′–	546′–709′	150′–300′	**225′–370′**
1,152′–1,200′	1,290′–1,350′	1,115′–1,123′	700′–805′+	808′–852′
1,355′–1,545′	1,495′–1,670′	1,280′–1,476′	Not reached	1,015′–1,205′
1,730′–1,840′	1,883′–1,986′	1,620′–1,713′		1,392′–1,489′
Queenston	Queenston	Queenston	Camillus	Queenston
1,952′	2,036′	1,721′	805′	1,512′
Salt bed 1,152′–1,200′. 175 Mcf. of gas. I.R.P. 500 #.	Salt Bed 1,290′–1,350′. Gas at 1,983′. 110 Mcf. of gas I.R.P. 420 lb.	Salt bed 1,115′–1,123′. Show of gas top of Red Medina	Salt bed 775′–805′. Second or third salt mine in N. Y. State.	Salt bed 808′–852′. Smoke at 1,060′. Water at 1,130′. Show of gas at 1,485′. Dry Hole.

TABLE II A—Continued

GENESEE COUNTY

QUADRANGLE		CALEDONIA	CALEDONIA	CALEDONIA	BATAVIA
Map Number		8	9	10	11
Name of Well		C. Davis #1	C. Johnson #1	J. Martin #1	Salt well
Operator			Alden-Batavia Nat. Gas Co.	Pavilion Nat. Gas Co.	
Township		Pavilion	Pavilion	Pavilion	Pavilion
Latitude		5,850′ North of 42°55′	15,100′ South of 42°55′	13,100′ South of 42°55′	4,400′ North of 42°55′
Longitude		8,500′ East of 77°55′	9,200′ East of 78°00′	5,550′ East of 78°00′	6,500′ West of 78°00′
Date Completed		3/19/26	10/19/13	1919	
Elevation		910′	1,120′	1,120′	953′
Tully					
Onondaga		247′–389′	550′–690′	585′–730′	238′–384′
Oriskany					
Salt Zone		821′–866′	1,065′–1,205′	1,205′–1,250′	838′–879′+
Lockport		1,042′–1,246′	1,400′–1,585′	1,420′–1,600′	Not reached
MEDINAN	Red Medina (Grimsby)	1,416′–1,523′	1,792′–1,895′	1,798′–1,901′	
	White Medina (Whirlpool)				
Deepest FM		Queenston	?	Trenton	Camillus
Total Depth		1,547′	1,895′	4,082′	879′
Remarks		Salt bed 821′–866′. Smoke at 1,082′. Black water at 1,148′. Gas at 1,438′.	Salt bed 1,065′–1,205′. Gas in Medina at 1,875′ and 1,885′. I.O.F. 5,000 Mcf. of gas.	Salt bed 1,205′–1,250′. Some gas in Medina at 1,894′.	Salt bed 838′–879′. Well stopped in salt zone.

TABLE II A—Continued

GENESEE COUNTY		LIVINGSTON COUNTY		
BATAVIA	BATAVIA	CALEDONIA	WAYLAND	HONEOYE
12	13	1	2	3
Wm. Smead #2	C. H. Ivison #1	Salt well	Dansville well	Salt well #4
Alden-Batavia Gas Co.			Dansville Oil, Gas & Min. Co.	Conesus Lake Salt & Min. Co.
Pavilion	Stafford	Caledonia	N. Dansville	Livonia
6,200′ South of 42°55′	11,500′ North of 42°55′	7,500′ North of 42°55′	14,100′ South of 42°35′	1,500′ North of 42°50′
3,450′ East of 78°05′	11,650′ West of 78°00′	9,850′ East of 77°55′	2,000′ West of 77°40′	9,300′ West of 77°40′
3/25/13	8/26/26	Before 1893	Before 1893	Before 1893
1,060′	930′	695′	930′	824′
465′–605′	215′–360′	26′–174′	1,700′–1,780′	508′–648′
1,045′–1,095′	780′–812′	650′–675′	2,100′–2,160′	978′–1,053′+
1,240′–1,436′	965′–1,168′			Not reached
1,605′–1,715′	1,334′–1,430′			
Queenston	Queenston	Silurian	Silurian	Camillus
1,827′	1,446′	748′	2,240′	1,053′
Salt bed 1,045′–1,095′. 200 Mcf. of gas in Medina at 1,708′–1,715′. I.R.P. 450 #.	Salt bed 780′–812′. Smoke at 1,015′. Black water at 1,030′. Some gas in Medina. Dry hole.	Salt bed 650′–675′. Salt well.	Salt bed 2,100′–2,160′. Limestone 2,160′–2,230′. Crooked hole 2,230′–2,240′. Salt well.	Salt beds 978′–1,003′, 1,033′–1,053′. Salt well.

TABLE II A—Continued

LIVINGSTON COUNTY

QUADRANGLE	CALEDONIA	HONEOYE	HONEOYE	CALEDONIA
Map Number	4	5	6	7
Name of Well	Geo. F. Hudson	Livonia salt well	Livonia salt shaft	Phoenix salt well
Operator	N. Y. Central Gas Co.		Livonia Salt & Min. Co.	Phoenix Salt Company
Township	Leicester	Livonia	Livonia	Leicester
Latitude	7,400′ North of 42°45′	2,000′ South of 42°50′	12,900′ South of 42°50′	6,800′ North of 42°45′
Longitude	8,400′ East of 77°55′	600′ West of 77°40′	3,625′ West of 77°40′	10,950′ West of 77°50′
Date Completed		Before 1893	8/13/1892	1885
Elevation	585′	1,008′	1,082′	568′
Tully				
Onondaga	500′–630′	705′–845′	866′–1,001′	470′–610′
Oriskany				
Salt Zone	1,125′–1,205′	1,190′–1,228′+	1,348′–1,432′+	1,110′–1,145′
Lockport	1,400′–1,640′	Not reached	Not reached	Not reached
MEDINAN: Red Medina (Grimsby)	1,826′–1,901′			
MEDINAN: White Medina (Whirlpool)				
Deepest FM	Queenston	Camillus	Camillus	Camillus
Total Depth	1,938′	1,228′	1,432′	1,145′
Remarks	Salt bed 1,125′–1,205′. Gas at 1886′.	Salt bed 1,195′–1,228′. Salt well.	Salt beds 1,353′–1,381′, 1,389′–1,404′. Second or third salt mine in N. Y. State.	Salt beds 1,110′–1,114′, 1,117′–1,145′. Abandoned salt well.

Table II A—Continued

LIVINGSTON COUNTY

Caledonia	Nunda	Nunda	Wayland	Caledonia
8	9	10	11	12
Sterling salt shaft #1		Nunda well	Gruschow #1	E. Whitney #1
Sterling Salt Company	Royal Salt Company			Alden-Batavia Nat. Gas Co.
Leicester	Mount Morris	Nunda	Ossian	York
13,500′ North of 42°45′	6,800′ South of 42°45′	1,400′ South of 42°35′	7,700′ North of 42°30′	13,400′ South of 42°55′
9,500′ West of 77°50′	10,175′ West of 77°50′	6,600′ West of 77°55′	6,300′ East of 77°45′	6,700′ West of 77°55′
1905	1885	Before 1893	1926	4/23/14
614′	574′	958′	1,140′	908′
475′–	670′–820′	1,608′–1,818′	No record	435′–580′
947′–1,255′	1,290′–1,422′	2,060′–2,140′	2,450′–2,775′	985′–1,085′
1,398′–1,582′	Not reached	Not reached	Not recorded	1,257′–1,452′
1,778′–			3,550′–	1,636′–1,751′
1,848′–1,871′				
Queenston	Camillus	Silurian	No record	Queenston
1,909′	1,422′	2,225′	3,670′	1,805′
Salt beds 1,093′–1,115′, 1,167′–1,177′, 1,178′–1,194′, 1,196′–1,209′, 1,212′–1,223′. Fifth salt mine in N. Y. State.	Salt beds 1,294′–1,314′, 1,349′–1,422′. Salt well.	Salt beds 2,070′–2,105′. Small shows of oil from 543′ to 1,016′. Pyrite from 1,568 to 1,608′.	Salt beds 2,450′–2,500′, 2,530′–2,545′, 2,700′–2,775′. Show of gas at 875′.	Salt bed 985′–1,085′. 100 Mcf. of gas with I.R.P. of 410 #.

TABLE II A—Continued

LIVINGSTON COUNTY

QUADRANGLE	CALEDONIA	CALEDONIA	CALEDONIA	CALEDONIA
Map Number	13	14	15	16
Name of Well	J. J. Gilmore #1	Well #1	Fuller shaft #1	Shaft #1
Operator	Alden-Batavia Nat. Gas Co.	Livingston Salt Company	Retsof Mining Company	Retsof Mining Company
Township	York	York	York	York
Latitude	14,700′ South of 42°55′	750′ North of 42°50′	2,100′ South of 42°50′	1,325′ North of 42°50′
Longitude	8,350′ West of 77°50′	4,000′ West of 77°50′	8,450′ East of 77°55′	9,200′ East of 77°55′
Date Completed	Commenced 7/30/14	1883	Before 1899	1885
Elevation	690′	564′	732.11′	680′
Tully				
Onondaga	208′–350′	265′–415′	443.2′–593.5′	402′–544′
Oriskany				
Salt Zone	795′–830′	868′–991′+	928′–1,160′+	962′–1,105′+
Lockport	1,025′–1,237′	Not reached	Not reached	Not reached
MEDINAN: Red Medina (Grimsby)	1,398′–1,518′			
MEDINAN: White Medina (Whirlpool)				
Deepest FM	?	Camillus	Camillus	Camillus
Total Depth	1,518′	991′	1,160′	1,141′
Remarks	Salt bed 795′–830′. Dry well in Pavilion Field.	Salt beds 868′–886′, 892′–903′, 907′–909′, 929′–991′. Salt well.	Salt beds 1,056′–1,074′, 1,104′–1,108′, 1,114′–1,117′, 1,127′–1,142′, 1,146′–1,160′. Main shaft now being used.	Salt beds 995′–1,015′, 1,041′–1,045′, 1,047′–1,105′. First salt mine in N. Y.

TABLE II A—Continued

LIVINGSTON COUNTY			MADISON COUNTY	
CALEDONIA	CALEDONIA	WAYLAND	MORRISVILLE	SANGERFIELD
17	18	19	1	2
Well #1	Shaft #1	Harold Hunt #1	Dwight Graham #1	Letts #1
York Salt Company	Greigsville Mining Co.	Livingston Oil & Gas Co.		Sangerfield Gas & Oil Co.
York	York	Conesus	Eaton	Brookfield
12,650′ North of 42°50′	Unknown	12,100′ North of 42°40′	11,800 South of 42°55′	10,000′ North of 42°50′
4,525′ West of 77°50′	Unknown	750′ West of 77°40′	6,600′ West of 75°40′	3,800′ East of 75°25′
1884	October 1892	5/29/56	1887	1936
568′		1,600′ Alt.	1,260′	1,220′
180′–320′		1,815′–1,953′	371′–441′	490′–525′
		Not present	Not present	525′–539′
744′–828′+		2,173′–2,680′	1,259′–1,271′	Not present
		2,930′–3,075′		
		3,266′–3,366′		
		3,366′–3,396′		
Camillus	Camillus?	Medina	Silurian	Cambrian
828′		3,398′	1,889′	3,642′
Salt beds 750′–760′, 787′–828′. Salt well.	Fourth salt mine in New York. Section omitted for lack of information.	Salt zone 2,173′–2,680′, 304 Mcf. of gas a/f at 3,390′–3,396′. Shows of gas at 1,715′ & 1790′. Oil and gas show in Lockport.	Salt bed 1,259′–1,271′. Pockets of gas at 578′ and 755′. Better known as the Morrisville well.	No salt. Gas shows 532′, 546′, 576′, 1,550′, 1,585′, 1,914′–1,943′, and in Trenton below 3,328′. Little Falls between 3,500′ & 3,506′. Not of commercial value.

Table II A—Continued

			MADISON COUNTY	MONROE COUNTY		ONONDAGA COUNTY
Quadrangle			Chittenango	Honeoye	Brockport	Tully
Map Number			3	1	2	1
Name of Well			Chittenango well	Honeoye Falls well	Reber #1	Cardiff
Operator						Solvay Process Co.
Township			Sullivan	Mendon	Riga	Lafayette
Latitude			11,800′ South of 43°05′	13,000′ North of 42°55′	1,600′ North of 43°05′	10,000′ South of 42°55′
Longitude			9,900′ West of 75°50′	9,400′ West of 77°35′	2,600′ West of 77°50′	6,200′ East of 76°10′
Date Completed			1890	1887	1934	1888
Elevation			444′	685′	542′	620′ Est.
Tully						
Onondaga				13′–88′		244′–392′
Oriskany						
Salt Zone			500′–	Not present	Not present	No record
Lockport			515′–567′	884′–1,284′	30′–301′	
Medinan	Red Medina (Grimsby)		906′–954′	1,284′–	430′–508′	744′–
	White Medina (Whirlpool)			–1,500′		
Deepest FM			Trenton	Medina	Queenston	Silurian
Total Depth			3,027′	1,500′	512′	840′
Remarks			Some salt at 500′. Oneida Congl. 890′–906′. Queenston 954′–1,410.′ Oswego 1,410′–1,517′. Lorraine 1,517′–2,157′. Utica 2,157′–2,450′. Trenton 2,450′–.	No indication whether gas was found or not. No salt.	Show of gas at 282′, 442′, and 497′. No salt.	Location in vicinity of Cardiff.

TABLE II A—Continued

ONONDAGA COUNTY			ONTARIO COUNTY	
TULLY	TULLY	TULLY	CANANDAIGUA	CANANDAIGUA
2	3	4	1	2
Solvay well D-1	Solvay well S-2	Solvay well V-25	B. Case #1	Lynn Gladding #1
Solvay Process Co.	Solvay Process Co.	Solvay Process Co.	Penn York	Great Northern Nat. Gas Corp.
Tully	Tully	Tully	Bristol	Bristol
2,600′ North of 42°50′	4,500′ South of 42°50′	5,400′ South of 42°50′	3,900′ North of 42°50′	9,400′ South of 42°50′
9,700′ West of 76°10′	9,200′ East of 76°10′	3,500′ East of 76°10′	2,400′ East of 77°25′	8,000′ West of 77°25′
			11/12/45	Aug. 1934
744.1′	727.46′	844.5′	938′	1,422′
528′–645′	488′–548′		603′–715′	1,210′–1,345′
645′–660′	548′–565′		No record	1,345′–1,350′
1,072′–1,194′+	1,026′–1,262′+	1,279′–1,450′+	1,230′–1,464′	1,695′–2,145′
Not reached	Not reached	Not reached	1,676′–1,873′	2,300′–2,435′
			2,083′–2,140′	2,756′–2,870′
Camillus	Camillus	Camillus	Queenston	Queenston
1,245′	1,280′	1,455′	2,268′	2,900′
Salt beds 1,072′–1,115′, 1,140′–1,194′. Stopped in salt zone.	Salt beds 1,026′–1,046′, 1,077′–1,120′, 1,170′–1,262′. Stopped in salt zone.	Salt beds 1,279′–1,300′, 1,312′–1,340′, 1,387′–1,450′. Stopped in salt zone.	Salt beds 1,415′–1,423′, 1,457′–1,464′. Gas in clear salt. Gas at 2,189′. 52 Mcf. of gas increase to 165 Mcf. I.R.P. 250 #.	Salt beds 1,785′–1,790′, 1,815′–1,850′. Show of gas at 95′, 1,625′, and 2,100′. Main flow at 2,860′–2,869′. I.O.F. 425 Mcf. I.R.P. 600 #.

TABLE II A—Continued

ONTARIO COUNTY

QUADRANGLE		CANANDAIGUA	CANANDAIGUA	CANANDAIGUA	CANANDAIGUA
Map Number		3	4	5	6
Name of Well		A. Henish	Rubenstein #1	Amelia Smith	Weaver #1
Operator			Mid-East Oil & Gas Co.	Republic	Weaver et al.
Township		Bristol	Bristol	Bristol	Bristol
Latitude		2,700′ North of 42°50′	7,000′ South of 42°50′	400′ North of 42°50′	3,000′ South of 42°50′
Longitude		3,500′ East of 77°25′	6,950′ West of 77°25′	1,200′ East of 77°25′	9,200′ West of 77°25′
Date Completed		1941	1933	1909	
Elevation		865′	1,320′	894′	1,190′
Tully					
Onondaga		530′–640′	1,078′–1,170′	700′–825′	No record
Oriskany		No record	1,195′–1,205′	No record	
Salt Zone		1,270′–1,286′	1,600′–1,945′	1,440′–1,542′	1,445′–1,820′
Lockport		1,612′–1,925′	2,170′–2,395′	1785′–2,075′	No record
MEDINAN	Red Medina (Grimsby)	2,030′–	2,615′–2,726′	2,219′–	2,440′–
	White Medina (Whirlpool)				
Deepest FM		Queenston	Queenston	Queenston	Queenston
Total Depth		2,154′	2,745′	2,417′	2,604′
Remarks		Salt bed 1,270′–1,286′. Gas show at 225′ and 2,134′.	Salt beds 1,600′–1,635′, 1,930′–1,945′. Gas shows at 470′, 560′, 567′; 633 Mcf. of gas at 2,718′–2,726′ I.R.P. 600 #. Gas at top of Onondaga. 150 Mcf.	Salt beds 1,440′–1,450′, 1,530′–1,542′. 175 Mcf. of gas in Medina.	Salt beds 1,445′–1,455′, 1,775′–1,798′. No gas or water

Table II A—Continued

ONTARIO COUNTY

Canandaigua	Phelps	Phelps	Phelps	Naples
7	8	9	10	11
C. R. Brown #1	J. W. Birdseye	D. L. Kunes #1	C. Root	Monier Estate #1
J. B. Reed et al.		Bel. Quad. Drlg. Corp.	Ontario Syn. Co.	Penn Oil Co.
Canandaigua	Gorham	Gorham	Gorham	Naples
9,700′ North of 42°55′	3,700′ North of 42°50′	12,500′ South of 42°50′	400′ South of 42°50′	10,800′ North of 42°35′
1,200′ West of 77°15′	800′ West of 77°10′	9,300′ West of 77°15′	9,800′ East of 77°15′	5,200′ East of 77°25′
1/14/33		1/13/31	1910	1880
663′	935′	1,110′	995′	750′+−
	18′?−			
−125′	330′?−			1,265′ Est.−
No record				
524′–770′	1,010′–1,405′	1,760′–1,770′	1,068′–1,415′	1,590′–1,633′+
916′–1,221′	1,638′−	2,000′–2,212′		
1,402′–1,474′	2,070′–2,175′	2,435′–2,540′	2,080′–2,190′	
1,474′–1,533′		2,540′–2,550′		
Queenston	Queenston	Queenston	Queenston	Camillus
1,551′	2,234′	2,641′	2,234′	1,633′
Salt bed 753′–759′. Gas and water at 730′. Dry hole. Black water at 1,060′.	Salt beds 1,010′–1,068′, 1,375′–1,405′. Gas approx. 60 Mcf. at 370′. Gas at 1,318′ and 1,400′.	Salt bed 1,760′–1,770′. Gas at 2,050′. Water well.	Salt beds 1,068′–1,115′, 1,405′–1,415′. Queenston at 2,190′.	Salt bed 1,590′–1,633′. Discovery well of Naples Field. Stopped in salt.

Table II A—Continued

ONTARIO COUNTY

Quadrangle		Phelps	Geneva	Canandaigua	Honeoye
Map Number		12	13	14	15
Name of Well			Pat O'Connor #1	Abbey #1	D. Curran #1
Operator			Geneva Nat. Gas Corp.	Ontario Gas Company	Ontario Gas Company
Township		Phelps	Phelps	Richmond	Richmond
Latitude		?	1,650′ South of 42°55′	6,800′ North of 42°50′	5,100′ North of 42°50′
Longitude		?	2,850′ East of 77°00′	2,100′ East of 77°30′	9,900′ West of 77°30′
Date Completed		Before 1900	4/28/33	1913	1899
Elevation		660′ Topo	471′	920′	820′
Tully					
Onondaga			-122′	610′-730′	470′-600′
Oriskany					600′-606′
Salt Zone		650′-	542′-735′	1,360′-1,380′	1,275′-1,335′
Lockport			939′-1,130′	1,600′-1,860′	1,475′-1,810′
Medinan	Red Medina (Grimsby)		1,397′-1,410′	2,032′-	1,892′-
	White Medina (Whirlpool)				
Deepest FM		Camillus	Trenton ?	Queenston	Queenston
Total Depth		680′	2,967′	2,221′	2,059′
Remarks		Salt at 650′. Location: One mile south of Clifton Springs.	First salt at 542′. Last salt at 735′. Oswego 2,462′-2,696′. *(*)	Salt bed 1,360′-1,380′. Gas at 2,137′.	Salt bed 1,275′-1,335′. No gas. Oil sand 600′-606′.

TABLE II A—Continued

ONTARIO COUNTY		SCHUYLER COUNTY		
HONEOYE	CANANDAIGUA	ITHACA	WATKINS	WATKINS
16	17	1	2	3
Callister #1	E. Darby #1	D. Hager #1	Federal Land Bank #1	Well #11
Ontario Gas Company	George Drury	Benedum and Trees	Belmont Quad. Drlg. Corp.	Watkins Salt Company
West Bloomfield	Bristol	Catherine	Dix	Hector
11,900′ North of 42°50′	12,100′ South of 42°50′	On 42°20′ Lat. Line	4,900′ South of 42°20′	10,300′ South of 42°25′
4,000′ West of 77°30′	8,700′ West of 77°25′	14,500′ West of 76°40′	8,250′ West of 76°50′	5,750′ West of 76°50′
1894	10/26/56	4/22/31	3/31/38	11/ /42
865′	1,485′ Topo.	1,472′	1,206′	443′
		1,215′–	920′–973′	280′–310′
450′–590′	No record	2,385′–2,455′	2,009′–	1,290′–1,360′
	No record	Horizon 2,455′–	Absent	1,360′–1,370′
1,193′–1,510′	1,920′–2,240′	2,900′–4,175′	2,524′–3,862′	1,800′–1,945′+
–1,770′		4,990′–	4,685′–	Not reached
1,860′–	2,927′–		5,298′–5,473′	
			5,473′–5,538′	
Queenston	Red Medina	M. Silurian	U. Ordovician	Camillus
2,042′	3,060′	5,115′	6,600′	1,945′
Salt bed 1,218′–1,227′. Gas pocket at 431′. Main gas at 1,945′–1,955′. Well known as "Gates Mill Deep Well." 75 Mcf. of gas. I.R.P. 600 #.	Salt beds 1,920′–1,970′, 2,210′–2,220′, 2,230′–2,240′. 3,315 Mcf. of gas in Red Medina at 3,042′.	Salt beds 2,900′–3,200′, 3,300′–3,405′, 3,480′–3,550′, 3,950′–3,955′, 4,040′–4,045′, 4,060′–4,130′. No gas, well dry.	Salt beds 2,524′–3,072′, 3,124′–3,290′, 3,362′–3,400′, 3,420′–3,430′, 3,445′–3,555′, 3,724′–3,862′. 1,010′ of salt; drilled to Oriskany in 1937. No gas. Deepened, 1938 by New Penn Dev. Co. Top Oswego 6,322′.	Salt beds 1,800′–1,900′, 1,910′–1,945′.

TABLE II A—Continued

SCHUYLER COUNTY

QUADRANGLE		WATKINS	HAMMONDSPORT	WATKINS	HAMMONDSPORT
Map Number		4	5	6	7
Name of Well		G. G. Hill	J. D. Engle #2	Well #18	Best (Fee) #2
Operator		Consumers Nat. Gas Co.	Cobble Hill Oil & Gas Co.	International Salt Company	Belmont Quad.. Drlg. Corp.
Township		Dix	Orange	Reading	Tyrone
Latitude		12,500′ South of 42°25′	3,100′ North of 42°20′	1,750′ North of 42°25′	7,100′ South of 42°30′
Longitude		13,200′ West of 76°50′	1,500′ West of 77°05′	5,600′ East of 76°55′	1,500′ East of 77°05′
Date Completed		1903	11/5/31	10/17/36	9/12/33
Elevation		685′	1,777′	633′ Est.	1,248′
Tully			1,969′–	501′–534	862′–882′
Onondaga		1,468′–1,537′	3,068′–	1,488′–1,576′	1,725′–1,800′
Oriskany		1,537′–1,557′	Horizon 3,146′–3,160′	No record	1,800′–1,816′
Salt Zone		2,005′–2,820′	3,420′–	2,022′–2,489′+	2,166′–2,850′
Lockport		3,015′–3,125′	Not reached	Not reached	
MEDINAN	Red Medina (Grimsby)	3,315′–			4,105′–4,211′
	White Medina (Whirlpool)				4,211′–4,215′
Deepest FM		Red Medina	Camillus	Camillus	Queenston
Total Depth		3,424′	3,800′	2,494′	4,459′
Remarks		Salt beds 2,005′–2,270′, 2,310′–2,338′, 2,378′–2,450′, 2,507′–2,517′, 2,537′–2,560′, 2,630′–2,680′, 2,810′–2,820′. Considerable gas produced but source is not stated. Some from the Oriskany.	Top of salt at 3,420′. No gas. Dry well.	Salt beds 2,022′–2,226′, 2,259′–2,320′, 2,381′–2,410′, 2,423′–2,489′. Deepened in 1938 to salt beds.	Salt beds 2,166′–2,270′, 2,280′–2,372′, 2,441′–2,600′, 2,755′–2,850′. Gas from the Oriskany. 140 Mcf.

Table II A—Continued

SENECA COUNTY		**STEUBEN COUNTY**		
Ovid	Geneva	Bath	Hornell	Corning
1	2	1	2	3
Carrie Chapman #1	Seneca Falls well #12	Blair #1	G. H. Losey #1	E. Collins #1
Belmont Quad. Drlg. Corp.	W. A. Hoseley	Anchor Pet. Company	Whittmer Oil & Gas	G. L. Cabot, Inc.
Ovid	Seneca Falls	Bath	Dansville	Erwin
3,000′ North of 42°40′	13,600′ North of 42°55′	9,400′ South of 42°20′	13,200′ North of 42°25′	5,000′ North of 42°10′
8,900′ West of 76°45′	3,200′ West of 76°45′	1,800′ West of 77°15′	2,500′ West of 77°35′	7,300′ West of 77°10′
8/22/33	1895	1/26/54	2/6/36	2/13/41
879′	395′	1,090′	1,859′	1,718′
241′–263′		1,815′–1,850′	2,528′–2,568′	2,915′–2,965′
1,134′–1,184′		2,580′–2,636′	3,173′–3,243′	3,788′–3,802′
1,184′–1,210′		2,636′–2,657′	Horizon 3,243′–	3,802′–3,846′
1,575′–1,997′	305′–455′	2,976′–	3,530′–3,565′	4,225′–5,200′
2,703′–	710′–1,085′	Not reached	4,015′–4,142′	5,875′–6,049′
3,106′–	1,205′–		4,185′–4,295′	6,522′–6,666′
				6,666′–6,725′
Queenston	M. Ordovician	Camillus	Queenston	Queenston
3,406′	3,560′	3,347′	4,371′	6,825′
Salt beds 1,678′–1,706′, 1,720′–1,772′, 1,887′–1,925′, 1,939′–1,962′, 1,984′–1,997′. Sulphur water in Oriskany. No gas.	Salt sand 305′–455′. Show of gas at 1,254′. Show of gas at 500′ below top of Trenton. Trenton 3,000′.	Storage well for L.P.G. Salt beds 2,976′–3,223′, 3,250′–3,347′. Dry, no gas or salt water in Oriskany. Stopped in salt zone. *	Salt bed 3,530′–3,565′. This well was drilled in 1935 to 3,469′ and deepened in 1936 to the Queenston.	Salt beds 4,225′–4,348′, 5,108′–5,145′. Oriskany salt water, no gas. A little gas at 6,630′. *

Table II A—Continued

STEUBEN COUNTY

Quadrangle	Bath	Hammondsport	Woodhull	Bath
Map Number	4	5	6	7
Name of Well	Daltry #1	C. Champlin #1	R. Harrington #1	B. Schultz #1
Operator	Sawyer-Robinson	General Foods Corp.	R. Atwater et al.	Whitman Oil & Gas
Township	Prattsburg	Urbana	Woodhull	Avoca
Latitude	2,900′ South of 42°30′	5,400′ South of 42°25′	5,300′ South of 42°05′	7,000′ South of 42°25′
Longitude	1,400′ West of 77°15′	13,100′ West of 77°10′	1,600′ East of 77°25′	300′ East of 77°25′
Date Completed	8/ /30	3/21/46	5/25/37	2/1/36
Elevation	1,345′	730′	1,546′	1,179′
Tully	1,364′–1,377′	995′–1,033′	3,147′–3,187′	1,918′–1,948′
Onondaga	2,100′–2,145′	1,823′–1,871′	3,914′–3,955′	2,585′–2,650′
Oriskany	2,145′–2,175′	1,871′–1,877′	3,955′–3,980′	2,650′–2,662′
Salt Zone	2,295′–	2,196′–2,471′	4,330′–5,505′	2,930′–
Lockport	Not reached	Not reached	6,270′–	Not reached
Medinan: Red Medina (Grimsby)			6,886′–7,066′	
Medinan: White Medina (Whirlpool)				
Deepest FM	Camillus	Camillus	Oswego	Camillus
Total Depth	2,504′	2,471′	8,625′	3,140′
Remarks	Rock salt at 2,295′. Oriskany dry tight sand. No gas.	Salt beds 2,196′–2,238′, 2,279′–2,318′, 2,378′–2,395′. Gas blowouts in salt shale. Drilled for salt. Oriskany-tight, thin-broken s.s.	Salt beds 4,330′–4,850′, 5,255′–5,285′, 5,350′–5,450′, 5,460′–5,505′. Discovery well of the Woodhull (Oriskany) Field. Salt water in Oswego. Top Oswego 7,965′. Deepened, 1944 by New Penn Dev. Co., et al.	Salt beds 2,930′–2,980′ 3,008′–3,070′ 3,140′–? Stopped in salt. Oriskany dry poor sand. Show of gas at 3,112′.

TABLE II A—Continued

TIOGA COUNTY		TOMPKINS COUNTY		
OWEGO	OWEGO	ITHACA	ITHACA	GENOA
1	2	1	2	3
C. Miller #1	K. Pompelly #1	Ithaca deep well #1	Remington salt well	Cayuga Rock salt core
Tioga Utilities	Susquehanna Natural Gas	Ithaca Salt Works	Remington Salt Company	Cayuga Rock Salt Co., Inc.
Candor	Owego	Ithaca	Ithaca	Lansing
9,700′ North of 42°10′	200′ North of 42°05′	5,200′ North of 42°25′	10,800′ South of 42°30′	18,150′ South of 42°35′
400′ West of 76°15′	5,900′ West of 76°15′	2,500′ West of 76°30′	1,100′ West of 76°30′	9,100′ West of 76°30′
1932	1931	Prior to 1888	1901	1917
1,020′	980′	396′	400′	410′
2,100′–2,170′	2,264′–2,330′	440′–470′	365′–395′	
	3,904′–3,960′?	1,692′–1,772′	1,555′–1,650′	936′–1,012′
3,390′–3,398′	4,023′–4,028′	1,772′–1,785′	1,650′–1,665′	1,012′–1,021′
		2,244′–2,714′	1,947′–2,189′+	1,403′–1,952′+
No record	Not reached	Not reached	Not reached	Not reached
Silurian	Helderberg-Manlius	U. Silurian	Camillus	Camillus
4,360′	4,130′	3,185′	2,192′	1,964′
8 feet of Oriskany sand. Dry.	Only a few grains of sand. Dry. No gas. Believe the Schoharie-Esopus interval is present.	Salt beds 2,244′–2,268′, 2,274′–2,328′, 2,340′–2,357′, 2,388′–2,409′ 2,476′–2,518′ 2,542′–2,590′, 2,672′–2,714′. Show of gas in the Genesee, Hamilton and Marcellus.	Salt beds 1,947′–2,095′, 2,095′–2,137′, 2,145′–2,189′, No gas; dry in Oriskany.	Salt beds 1,403′–1,408′, 1,434′–1,437′, 1,452′–1,553′, 1,555′–1,571′, 1,579.5′–1,583′, 1,695′–1,840′, 1,893′–1,952′. Cayuga Rock Salt Mine shaft southeast of this core location. Sixth salt mine in N. Y. State.

TABLE II A—Continued

	TOMPKINS COUNTY	WAYNE COUNTY		WYOMING COUNTY
QUADRANGLE	GENOA	CLYDE	CLYDE	ARCADE
Map Number	4	1	2	1
Name of Well	Joe Farkas #1	Charles Noble	Alloway #1	K. R. Wilson #1
Operator	Reserve Oil Corp.	H. J. Hadley et al.	J. W. Stearns	K. R. Wilson
Township	Lansing	Galen	Lyons	Arcade
Latitude	10,650′ North of 42°30′	3,800′ South of 43°05′	7,900′ North of 43°00′	11,400′ North of 42°30′
Longitude	2,000′ West of 76°30′	6,000′ West of 76°50′	3,500′ East of 77°00′	1,700′ West of 78°25′
Date Completed	1930–32	11/16/33	1899	8/ /46
Elevation	850′	410′	420′	1,474′
Tully	195′–215′			1,750′–1,769′
Onondaga	1,416′–1,528′			2,140′–2,215′
Oriskany	Horizon 1,528′–1,547′			2,215′–2,274′
Salt Zone	2,507′–3,117′			2,500′–2,777′
Lockport	3,422′–3,618′	353′–510′	580′–	2,925′–3,144′
MEDINAN: Red Medina (Grimsby)	3,980′–	810′–	980′–	3,290′–3,346′
MEDINAN: White Medina (Whirlpool)				3,346′–3,365′
Deepest FM	Trenton	Trenton	Oswego	Cambrian
Total Depth	6,210′	3,150′	2,365′	7,144′
Remarks	Salt beds 2,507′–2,557′, 2,563′–2,610′, 2,620′–2,650′, 2,727′–2,739′. Top of Oswego 4,770′. Top of Trenton 6,116′. Oriskany horizon in fault. *	Top of Oswego 1,740′. Top of Trenton 2,630′. No gas. Dry.	Top of Oswego 1,930′. Show of gas at 540′ and 650′. Dry. Salina shales 20′–580′.	Salt bed 2,760′–2,777′. Top of Oswego 4,460′–4,482′. Top of Trenton 5,265′. Cambrian 6,300′. Smoke 3,005′. Black water 3,050′. Gas pockets at 6,030′ & 6,182′. *

Table II A—Continued

WYOMING COUNTY

Attica	Attica	Portage	Portage	Caledonia
2	3	4	5	6
J. Mattison	L. C. Wilkie	Salt well	J. Harding #1	Wm. J. Armstrong #1
	Alden-Batavia Natural Gas	Castile Salt Company	Pawnee Oil & Gas Co.	Republic
Attica	Attica	Castile	Castile	Covington
5,800′ South of 42°50′	9,100′ North of 42°50′	13,300′ South of 42°40′	11,400′ South of 42°40′	4,500′ North of 42°50′
7,100′ East of 78°20′	12,200′ West of 78°15′	5,450′ East of 78°05′	10,800′ East of 78°05′	8,100′ East of 78°00′
1919	9/8/16	1884	12/24/31	2/1/26
1,040′	1,215′	1,367′	1,515′	1,195′
710′–855′	?	1,775′–1,915′	1,821′–1,955′	835′–980′
No record	No record	No record	Not present	No record
1,284′–1,292′	1,129′–1,185′	2,335′–2,525′+	2,462′–2,560′	1,422′–1,489′
1,460′–1,640′	1,435′–1,630′	Not reached	2,680′–2,958′	1,670′–1,881′
1,780′–1,865′	1,780′–1,872′		3,100′–3,139′	2,035′–
			3,139′–3,186′	–2,124′
Queenston	Queenston	Camillus	Queenston	Queenston
1,885′	1,880′	2,525′	3,214′	2,145′
Salt bed 1,284′–1,292′. No gas in Medina.	Salt bed 1,129′–1,185′. Black water at 1,514′. Gas shows at 1,803′ and 1,856′.	Salt bed 2,370′–2,415′. West of Castile.	Salt beds 2,462′–2,520′, 2,540′–2,560′. Salt water at 1,950′. Show of gas at 2,125′ and 3,184′. Show of good rock pressure.	Salt bed 1,422′–1,489′. Smoke at 1,760′. Black water at 1,770′. Dry hole, no gas.

Table II A—Continued

WYOMING COUNTY

Quadrangle		Batavia	Caledonia	Batavia	Batavia
Map Number		7	8	9	10
Name of Well		J. Broughton #1	F. Fagan #1	C. W. Jeffries #1	Moulton Well
Operator		Alden-Batavia Nat. Gas Co.		Alden-Batavia Nat. Gas Co.	
Township		Covington	Covington	Covington	Covington
Latitude		1,900′ North of 42°50′	4,400′ South of 42°50′	9,150′ North of 42°50′	1,700′ North of 42°50′
Longitude		4,200′ West of 78°00′	7,550′ East of 78°00′	9,550′ West of 78°00′	6,600′ East of 78°05′
Date Completed		9/27/15	10/2/25	7/ /15	Prior to 1893
Elevation		1,120′	1,080′	943′	946′
Tully					
Onondaga		629′–838′	790′–935′	495′–635′	555′–707′
Oriskany		No record	No record	No record	No record
Salt Zone		1,290′–1,315′	1,420′–1,485′	1,070′–1,140′	1,124′–1,236′+
Lockport		1,515′–1,705′	1,640′–1,900′	1,330′–1,517′	Not reached
Medinan	Red Medina (Grimsby)	1,902′–1,982′	2,041′–2,102′	1,700′–1,773′	
	White Medina (Whirlpool)				
Deepest FM		Queenston	Queenston	Queenston	Camillus
Total Depth		2,017′	2,161′	1,802′	1,241
Remarks		Salt bed 1,290′–1,315′. No gas.	Salt bed 1,420′–1,485′. No smoke. No black water. 15 Mcf. of gas.	Salt bed 1,070′–1,140′. Black water at 1,435′. Dry, no gas.	Salt bed 1,151′–1,236′. Stopped in salt zone. Salt well.

TABLE II A—Continued

WYOMING COUNTY

Caledonia	Arcade	Portage	Portage	Portage
11	12	13	14	15
J. B. Murphy #1	Bliss salt well	Salt well	Salt well	Salt well
Alden-Batavia Nat. Gas Co.	Bliss Salt & Oil Co.	Duncan Salt Company	Gainesville Salt Company	A. Kerr Bros. and Company
Covington	Eagle	Gainesville	Gainesville	Gainesville
10,400′ North of 42°50′	200′ South of 42°35′	3,750′ South of 42°40′	10,600′ South of 42°40′	4,750′ North of 42°40′
10,400′ East of 78°00′	750′ West of 78°15′	1,450′ East of 78°05′	10,600′ East of 78° 10′	8,300′ West of 78°05′
1914	Prior to 1893	Prior to 1893	Prior to 1893	Prior to 1893
1,090′	1,729′	1,354′	1,610′	1,312′
640′–780′	2,000′–2,100′	1,521′–1,661′	1,875′–2,000′	1,490′–1,630′
No record	No record	No record	No record	No record
1,240′–1,300′	2,900′–2,956′+	2,109′–2,254′+	2,450′–2,514′	2,015′–2,111′+
1,465′–1,650′	Not reached	Not reached	No report	Not reached
1,859′–1,954′				
Queenston	Camillus	Camillus	Lockport	Camillus
2,006′	2,956′	2,254′		2,111′
Salt bed 1,240′–1,300′. First gas at 1,924.′ I.O.F. 2,500 Mcf. gas. I.R.P. 420 #.	Salt bed 2,900′–2,956′. Stopped in salt zone. Salt well. Gas shows at 675′–1,300′, and 1,714′. Oil show at 1,300′.	Salt beds 2,124′–2,134′, 2,179′–2,254′. Salt well.	Salt beds 2,450′–2,480′, 2,508′–2,514′. Salt well. Shale down to Lockport. No report on Lockport top.	Salt beds 2,015′–2,040′, 2,071′–2,111′. Salt well.

TABLE II A—Continued

WYOMING COUNTY

QUADRANGLE	PORTAGE	BATAVIA	BATAVIA	BATAVIA
Map Number	16	17	18	19
Name of Well	Salt well #13	J. Q. Adams #1	M. Chase #1	S. P. Cox #2
Operator	Morton Salt Company		Republic	
Township	Castile	Middlebury	Middlebury	Middlebury
Latitude	4,000′ South of 42°40′	11,950′ North of 42°50′	2,200′ North of 42°50′	11,100′ North of 42°50′
Longitude	3,750′ East of 78°05′	10,500′ East of 78°10′	300′ West of 78°10′	3,050′ West of 78°05′
Date Completed		4/21/26	8/1/24	5/22/17
Elevation	1,345′	1,240′	1,180′	1,270′
Tully				
Onondaga	1,681′?–	720′–865′	819′–969′	785′–930′
Oriskany	No record	No record	No record	No record
Salt Zone	2,260′–2,361′+	1,288′–1,353′	1,419′–1,500′	1,375′–1,440′
Lockport	Not reached	1,524′–1,729′	1,620′–1,828′	1,600′–1,810′
MEDINAN: Red Medina (Grimsby)		1,903′–1,989′	2,000′–2,091′	1,969′–2,058′
MEDINAN: White Medina (Whirlpool)				
Deepest FM	Camillus	Queenston	Queenston	Queenston
Total Depth		2,006	2,121′	2,075′
Remarks	Salt beds 2,260′–2,278′, 2,310′–2,360′. Salt well.	Salt bed 1,288′–1,353′. Smoke at 1,594′. Black water at 1,604′. Medina gas 40 Mcf. Abandoned.	Salt bed 1,419′–1,500′. Smoke at 1,680′. Black water at 1,704′. Dry hole, no gas. Red Medina broken.	Salt bed 1,375′–1,440′. Gas 35 to 40 Mcf. Abandoned as a dry hole.

TABLE II A—Continued

WYOMING COUNTY

Batavia	Batavia	Caledonia	Caledonia	Portage
20	21	22	23	24
W. A. Hawley #1	Salt Vale #1	K. Davis #1	F. Eaton	Salt well
Republic	Crystal Salt Company	G. L. Cabot, Inc.	H. French	Perry Salt Company
Middlebury	Middlebury	Perry	Perry	Perry
7,300′ South of 42°50′	13,400′ North of 42°45′	15,100′ South of 42°50′	3,700′ North of 42°45′	12,250′ South of 42°45′
1,650′ West of 78°05′	6,900′ West of 78°05′	6,200′ East of 78°00′	1,350′ East of 78°00′	1,550′ West of 78°00′
11/12/24	1882	12/1/41	7/31/41	1887
955′	983′	1,185′	1,330′	1,335′
634′–764′	770′–916′	1,088′–1,239′	1,290′–1,425′	1,463′–
No record	No record	1,239′–1,248′	1,425′–1,433′	No record
1,232′–1,295′	1,325′–1,436′+	1,630′–1,710′	1,850′–1,906′	2,043′–2,163′+
1,437′–1,668′	Not reached	1,863′–2,080′	2,115′–2,340′	Not reached
1,835′–1,905′		2,226′–2,313′	2,522′–2,586′	
			2,586′–2,591′	
Queenston	Camillus	Queenston	Queenston	Camillus
1,957′	1,436′	2,343′	2,631′	2,181
Salt bed 1,232′–1,295′. Smoke at 1,532′. Black water at 1,536′. 8 Mcf. of gas at 1,900′. Dry hole.	Salt bed 1,375′–1,436′. Stopped in salt zone.	Salt bed 1,630′–1,710′. Black water at 1,970′. 73 Mcf. of gas at 2,291′–2,309′. I.R.P. 415 #.	Salt bed 1,850′–1,906′. Black water at 2,210′. No gas in Oriskany. Some salt water. No gas or water in Medina.	Salt beds 2,053′–2,068′, 2,138′–2,163′. Salt well.

TABLE II A—Continued

WYOMING COUNTY

QUADRANGLE		PORTAGE	BATAVIA
Map Number		25	26
Name of Well		Salt well	Salt well
Operator		Bradley Salt Company	Miller Salt Company
Township		Warsaw	Warsaw
Latitude		13,400′ South of 42°45′	4,250′ North of 42°45′
Longitude		4,350′ East of 78°10′	11,100′ West of 78°05′
Date Completed		1885	Around 1885
Elevation		1,329′	1,099′
Tully			
Onondaga		1,315′–1,540′	935′–1,082′
Oriskany			
Salt Zone		1,975′–2,029′+	1,494′–1,609′+
Lockport		Not reached	Not reached
MEDINAN	Red Medina (Grimsby)		
	White Medina (Whirlpool)		
Deepest FM		Camillus	Camillus
Total Depth		2,039′	1,609′
Remarks		Salt bed 1,975′–2,029′. Stopped in salt zone.	Salt bed 1,524′–1,609′. Stopped in salt zone.

TABLE II A—Concluded

YATES COUNTY

PENN YAN	PENN YAN	PENN YAN
1	2	3
J. T. Andrews #1	C. M. Russell	J. Sanderson #1
	Bel. Quad. Drlg. Corp.	J. Sanderson
Milo	Jerusalem	Milo
2,300′ South of 42°40′	1,500′ North of 42°35′	6,600 South of 42°40′
8,400′ West of 77°00′	800′ East of 77°10′	9,350′ West of 77°00′
1893	8/30/30	1931
730′	983′	836′
	625′–656′	200′–220′
	1,360′–1,468′	1,022′–1,055′
	1,468′–1,492′	1,055′–1,057′
1,200′–1,290′+		1,560′–1,760′+
	3,334′–	
U. Silurian	Medina	Camillus
2,053′	3,506′	1,760′
Bed of salt. 90′ thick at 1,200′; another bed 35′ thick. Small amount of gas. Near outlet of Keuka Lake.	Supposedly 400′ of good salt but no depth given. Small amount of salt water in Oriskany. Medina dry.	Oriskany 18″ thick. Salt water in Oriskany.

Table II B

INDEX OF NEW YORK WELL AND MINE RECORDS

RECORD	COUNTY	MAP NO.	PAGE
Abbey #1	Ontario	14	34
Adams, J. Q. #1	Wyoming	17	44
Alloway #1	Wayne	2	40
Andrews, J. T. #1	Yates	1	47
Armstrong, W. J. #1	Wyoming	6	41
Aultman-Hale #1	Cattaraugus	4	15
Aurora well	Cayuga	1	16
Bank of Angelica #3	Allegany	1	12
Beaver, G. H. #1	Genesee	2	22
Best Fee #2	Schuyler	7	36
Birdseye, J. W.	Ontario	8	33
Blair #1*	Steuben	1	37
Bliss salt well	Wyoming	12	43
Broughton, J. #1	Wyoming	7	42
Brown #1	Broome	1	13
Brown, C. R. #1 (*)	Ontario	7	33
Callister #1	Ontario	16	35
Cardiff	Onondaga	1	30
Case, B. #1	Ontario	1	31
Cayuga Rock Salt Co. core (*)	Tompkins	3	39
Chadwick, F. #1	Allegany	6	13
Champlin, C. #1 (*)	Steuben	5	38
Chapman, C. #1	Seneca	1	37
Chase, M. #1 (*P)	Wyoming	18	44
Chase—Troy Chemical Co. #1	Broome	4	14
Chick, C.	Genesee	5	23
Chittenango well	Madison	3	30
Collins, E. #1 *	Steuben	3	37
Connor, M. #1	Allegany	4	12
Cook, W. J. #1	Genesee	7	23
Cox, S. P. #2	Wyoming	19	44
Curran, D. #1	Ontario	15	34
Daltry #1	Steuben	1	38
Dansville well	Livingston	2	25
Darby, E. #1	Ontario	17	35
Davis, C. #1	Genesee	8	24
Davis, K. #1	Wyoming	22	45
Donelson, A. #1	Chautauqua	3	17
Eaton, F.	Wyoming	23	45
Engle, J. D. #2	Schuyler	5	36
Estee, C. M.	Chautauqua	4	17

TABLE II B—Continued

RECORD	COUNTY	MAP NO.	PAGE
Fagan, F. #1	Wyoming	8	42
Farkas, J. #1 * (*)	Tompkins	4	40
Federal Land Bank #1	Schuyler	2	35
Feldman, B. #1	Erie	7	22
Fuller shaft #1 (*)	Livingston	15	28
Gilmore, J. J. #1	Livingston	13	28
Gladding, L. #1	Ontario	2	31
Graham, D. #1	Madison	1	29
Greigsville salt shaft	Livingston	18	29
Gruschow, #1	Livingston	11	27
Hager, D. #1	Schuyler	1	35
Harding, J. #1	Wyoming	5	41
Harrington, R. #1 (*)	Steuben	6	38
Hawley, W. A. #1	Wyoming	20	45
Hazlett, M. #1 * (*P)	Delaware	1	20
Heist, F. W. #1	Erie	5	21
Henish, A.	Ontario	3	32
Hill, G. G.	Schuyler	4	36
Hills, W. #1	Cattaraugus	1	14
Homes, G. #1 *	Chautauqua	8	18
Honeoye Falls well	Monroe	1	30
Hotchkiss, H. #1	Cattaraugus	9	16
Hotchkiss, R. G. #1 *	Broome	3	14
Howard, C. #1	Cattaraugus	3	15
Howe, F.	Erie	4	21
Hudson, G. F.	Livingston	4	26
Hunt, H. #1	Livingston	19	29
Ithaca deep well #1	Tompkins	1	39
Ivison, C. H. #1	Genesee	13	25
Jeffries, C. W. #1	Wyoming	9	42
Johnson #1 (*)	Chautauqua	1	17
Johnson, C. #1	Genesee	9	24
Jones, H.	Erie	1	21
Kesselring, E. C. #1 * (*)	Chemung	2	19
King, A. #1 *P (*)	Allegany	5	13
Kunes, D. L. #1	Ontario	9	33
Lehigh salt shaft	Genesee	6	23
Letts #1	Madison	2	29
Livonia salt shaft	Livingston	6	26
Livonia salt well	Livingston	5	26
Lobdell, C. C. #1 * (*)	Chenango	1	19
Losey, G. H. #1	Steuben	2	37

TABLE II B—Continued

RECORD	COUNTY	MAP NO.	PAGE
Mahaney, J. C. * (*)	Cayuga	2	17
Marsh, W. #1	Cattaraugus	5	15
Martin, J. #1	Genesee	10	24
Mattison, J.	Wyoming	2	41
Miller, C. #1	Tioga	1	39
Monier Estate #1	Ontario	11	33
Morse, K. #1 * (*)	Chautauqua	7	18
Moulton well	Wyoming	10	42
Murphy, J. #1	Chemung	1	19
Murphy, J. B. #1	Wyoming	11	43
Newton, L. #1	Allegany	7	13
Noble, C.	Wayne	1	40
Norwich well #1	Chenango	2	20
Nunda well	Livingston	10	27
O'Connor, P. #1 *P (*)	Ontario	13	34
Oldham, C. L. #1 (*)	Cattaraugus	8	16
Overbaugh, P. #1 * (*)	Cortland	1	20
Partridge, A. #1	Genesee	3	23
Partridge, A. #2	Genesee	4	23
Pease, H. #1	Broome	2	13
Phoenix salt well	Livingston	7	26
Pompelly, K. #1 (*)	Tioga	2	39
Reber #1	Monroe	2	30
Reed, O. R. #1	Chautauqua	6	18
Remington salt well	Tompkins	2	39
Retsof salt shaft #1 (*)	Livingston	16	28
Richey, C. H. #1	Cattaraugus	6	15
Root, C.	Ontario	10	33
Rubenstein #1	Ontario	4	32
Russell, C. M.	Yates	2	47
Salt Vale	Wyoming	21	45
Salt well (#11)	Genesee	11	24
" "	Livingston	1	25
" " (#4)	"	3	25
" "	Wyoming	4	41
" "	"	13	43
" "	"	14	43
" "	"	15	43
" " (#13)	"	16	44
" "	"	24	45
" "	"	25	46
" "	"	26	46
Sanderson, J. #1	Yates	3	47
Schultz, B. #1	Steuben	7	38
Seneca Falls well #12	Seneca	2	37

TABLE II B—Concluded

RECORD	COUNTY	MAP NO.	PAGE
Sharp, J. W. #1 *	Cattaraugus	10	16
Smead, W. #2	Genesee	12	25
Smith, A.	Ontario	5	32
Solvay well D-1	Onondaga	2	31
" " S-2	"	3	31
" " V-25	"	4	31
Springville well	Erie	3	21
Sterling salt shaft (*)	Livingston	8	27
Strickland, J. P. #3	Cattaraugus	7	15
Suburban #2	Cortland	2	20
Sutter, C. J. #1	Cattaraugus	2	14
Vellone	Chautauqua	2	17
Weaver #1	Ontario	6	32
Weiss #1	Chautauqua	5	18
Well #1	Livingston	14	28
Well #1	"	17	29
Well #11 (*)	Schuyler	3	35
Well #18	"	6	36
Well #796 (*)	Erie	2	21
Whitney, E. #1	Livingston	12	27
Williams, T. J. & M.	Allegany	3	12
Wilkie, L. C.	Wyoming	3	41
Wilson, K. R. #1 * (*)	"	1	40
Well name unknown	Allegany	2	12
" " "	Erie	6	22
" " "	Genesee	1	22
" " "	Livingston	9	27
" " "	Ontario	12	34

Table II C
WELL RECORDS OF PENNSYLVANIA

PENNSYLVANIA

COUNTY		WARREN	WARREN	McKEAN	McKEAN
Quadrangle		Warren	Youngsville	Bradford	Smethport
Map Number		1	2	3	4
Name of Well		C. Erickson #1	Spetz #1	L. D. Wilson #18	M. Zerbe
Operator		C. E. Updegraff	Potter Develop. Co.	South Penn Oil Company	Potter Develop. Co.
Township		Elk	Pittsfield	Lafayette	Liberty
Latitude		5,335′ North of 41°55′	15,100′ South of 41°55′	6,500′ North of 41°45′	1,320′ South of 41°50′
Longitude		7,710′ West of 79°00′	8,870′ East of 79°30′	7,600′ East of 78°45′	7,235′ West of 78°20′
Date Completed		9/5/38	5/8/37	8/4/48	9/3/34
Elevation		1,926′	1,849′	1,545′	1,751′
Tully					4,202′–4,220′
Onondaga		4,104′–4,197′	3,752′–3,907′	4,655′–4,727′	4,678′–4,726′
Oriskany		4,197′–4,199′	Horizon 3,907′–3,918′	Absent	Absent
Salt Zone		4,600′–4,864′	4,277′–4,415′	5,127′–5,610′	5,073′–5,095′+
Lockport		4,982′–5,246′	4,655′–4,961′	5,749′–5,978′	Not reached
Medinan	Red Medina (Grimsby)	5,408′–	4,961′–5,126′	6,160′–6,209′	
	White Medina (Whirlpool)	–5,545′	5,126′–5,137′	6,209′–6,326′	
Deepest FM		Queenston	Queenston	Reedsville	Camillus
Total Depth		5,630′	5,165′	8,002′	5,135′
Remarks		Salt beds 4,600′–4,615′, 4,620′–4,630′. Show of gas 5,145′–5,148′. Black salt water 5,148′–5,150′. Show of gas 5,431′–5,433′.	Salt bed 4,277′–4,300′. No sandstone at Oriskany horizon. Black salt water at 4,690′ and 4,714′. White Medina, dry.	Salt beds 5,221′–5,253′, 5,341′–5,353′, 5,369′–5,381′, 5,556′–5,563′. Oswego 7,591′–7,672′. Top of Reeds-ville 7,672′. No sandstone at Oriskany horizon.	Salt bed 5,073′–5,095′. Results: 41 Mcf. of gas per day from U. Devonian sands.

TABLE II C—Concluded

PENNSYLVANIA

McKEAN	POTTER	TIOGA	ELK	BRADFORD
BRADFORD	COUDERSPORT	TIOGA	KANE	SAYRE
5	6	7	8	9
Derrick City Deep Well	A. E. Matteson #1	L. E. Shoemaker #1	Well No. 3737	A. Carver #1
Bradford Deep Well Co.	Potter Develop. Co.	Lycoming Nat. Gas Corp.	United Nat. Gas Co.	Parsons Bros.
Foster	Hebron	Lawrence	Highland	Ridgeburg
10,560′ South of 42°00′	3,960′ South of 41°50′	9,345′ South of 42°00′	5,385′ North of 41°35′	6,500′ South of 42°00′
20,700′ West of 78°30′	580′ West of 78°05′	5,280′ East of 77° 05′	792′ East of 78°50′	19,700′ East of 76°45′
1914	8/26/32	1931	1928	8/4/56
1,576′	2,180′	1,474′	1,836′	1,350′ (Bar.)
	4,567′–4,615′	2,909′–2,991′	4,872′–4,878′	2,864′–
4,065′–4,135′	5,147′–5,174′	3,913′–3,930′	5,310′–5,350′	4,222′–4,317′
4,135′–4,155′	Horizon 5,174′–5,179′	3,930′–3,980′	Not present	4,317′–4,364′
4,490′–4,713′	5,528′–5,561′+	4,424′–6,508′	5,734′–6,485′	4,900′–5,502′
5,085′–5,385′	Not reached	Not reached	6,696′–6,903′	
5,560′–5,642′			7,076′–7,175′	
5,642′–5,700′			7,175′–7,242′	
Queenston	Camillus	Vernon	Queenston	
5,820′	5,561′	7,148′	7,930′	7,220′
Salt beds 4,490′–4,520′, 4,596′–4,606′, 4,638′–4,685′, 4,693′–4,713′. A show of oil reported in Oriskany.	Salt beds 5,528′–5,533′, 5,540′–5,561′. No sandstone at Oriskany horizon.	Salt beds 5,092′–5,098′, 5,126′–5,132′, 5,158′–5,165′, 5,527′–5,552′, 6,233′–6,327′, 6,342′–6,349′. Dry in Oriskany. No salt water.	Salt beds 5,734′–5,746′, 5,758′–5,770′, 5,775′–5,788′, 5,794′–5,801′, 5,903′–5,910′, 5,994′–6,010′, 6,015′–6,045′, 6,050′–6,055′, 6,445′–6,450′, 6,480′–6,485′. Dry in White Medina. Completed as a small gas well in Upper Kane sand. One foot of sand at base of Onondaga.	No gas in Oriskany sandstone. Two reports on thickness of salt zone 536′ and 1,375′.

Table II D

INDEX OF PENNSYLVANIA WELL RECORDS*

RECORD	COUNTY	MAP NO.	PAGE
Carver, A. #1	Bradford	9	53
Derrick City deep well	McKean	5	53
Erickson, C. #1	Warren	1	52
Matteson, A. E. #1	Potter	6	53
Shoemaker, L. E. #1	Tioga	7	53
Spetz, #1 (*)	Warren	2	52
Well No. 3737	Elk	8	53
Wilson, L. D. #18	McKean	3	52
Zerbe, M.	McKean	4	52

* Sample analysis by C. R. Fettke.

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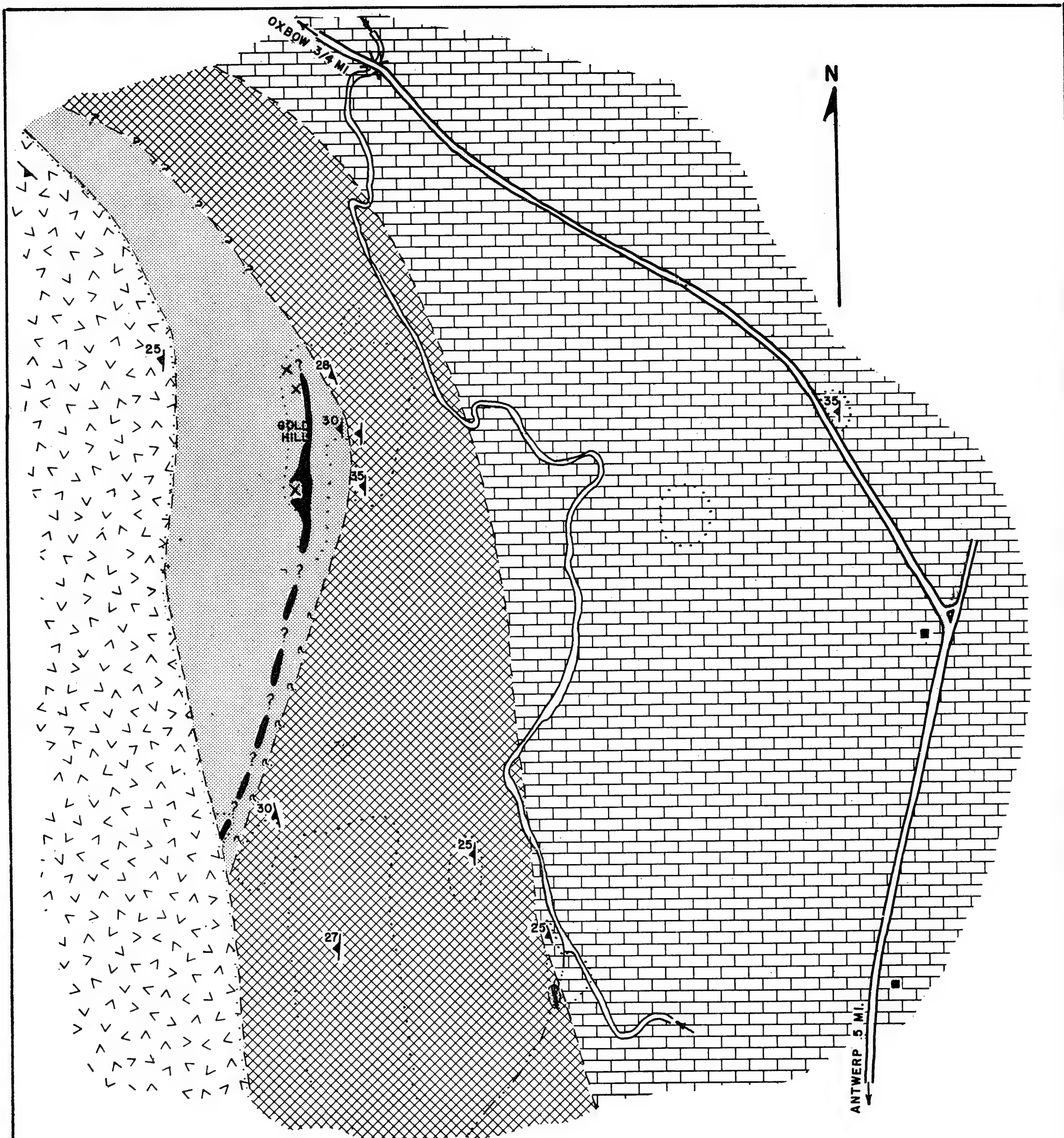


LEGEND

PRE-CAMBRIAN

- MARBLE
- GARNETIFEROUS QUARTZ-BIOTITE GNEISS
- RUSTY GNEISS, vein shown in solid black and broken where conjectural
- GNEISSIC GRANITE

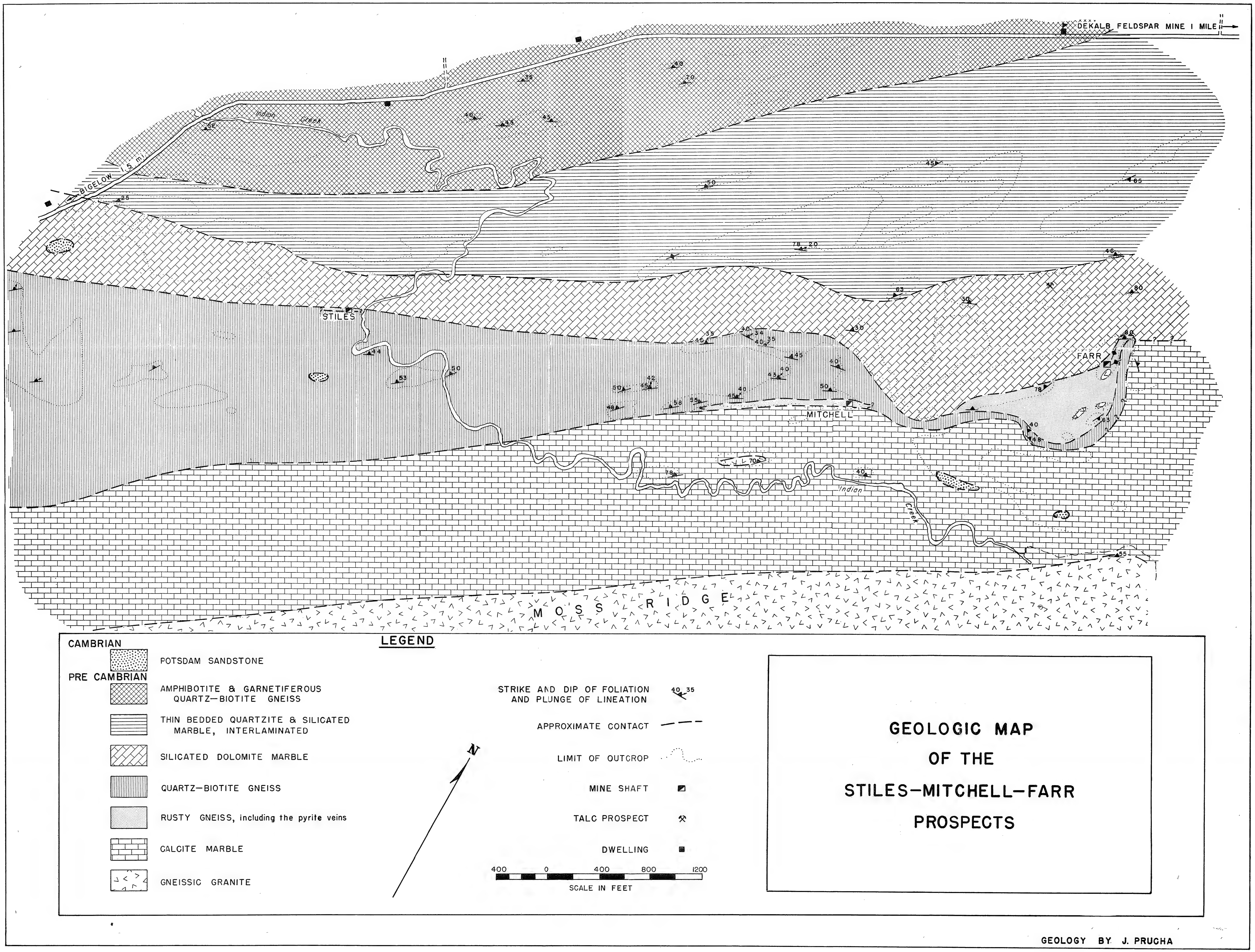
- APPROXIMATE CONTACT
- LIMIT OF OUTCROP
- 25 STRIKE AND DIP OF FOLIATION
- × PROSPECT PIT
- ■ DWELLING
- INTERMITTENT STREAM

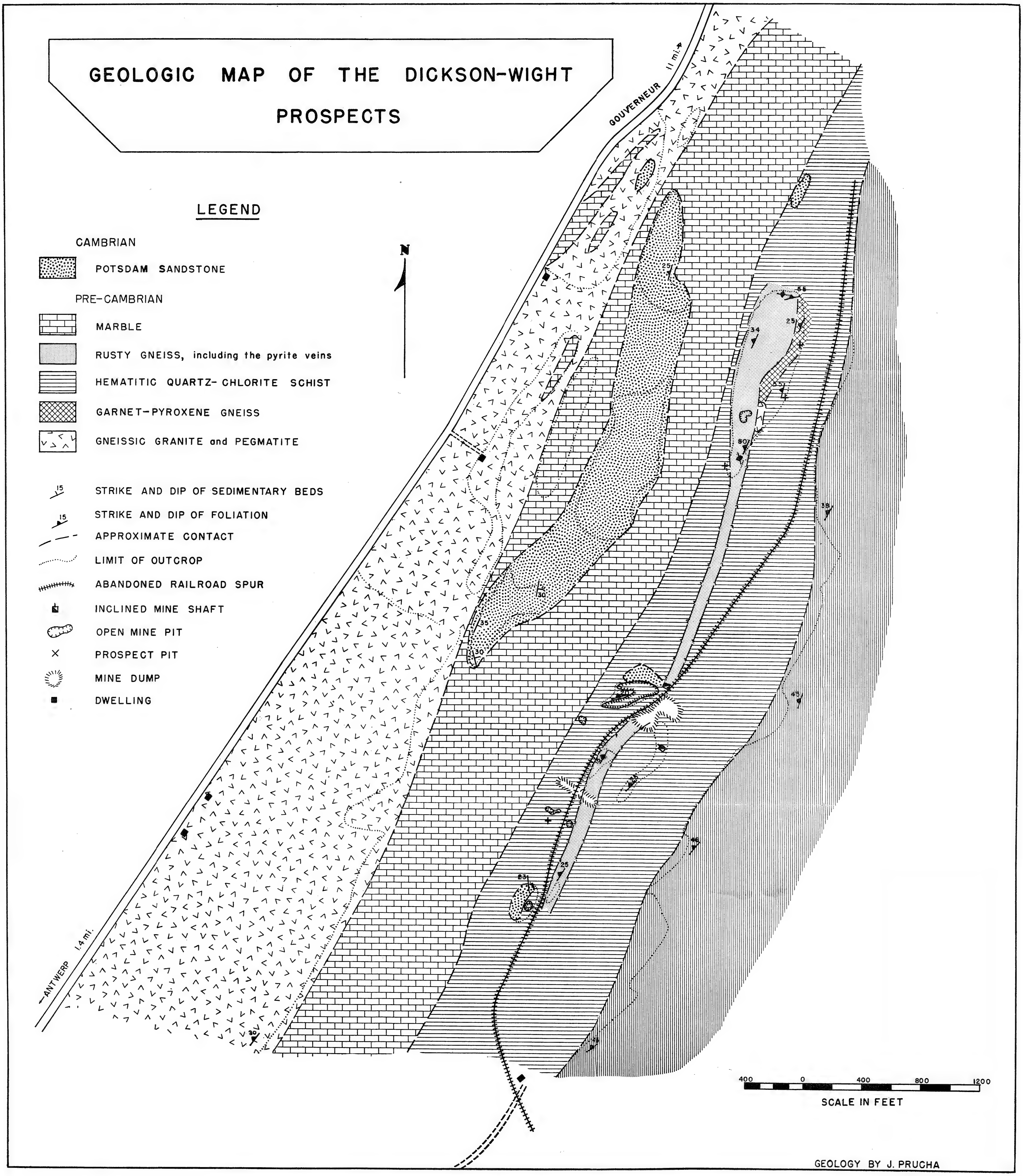
0 400 800 1200

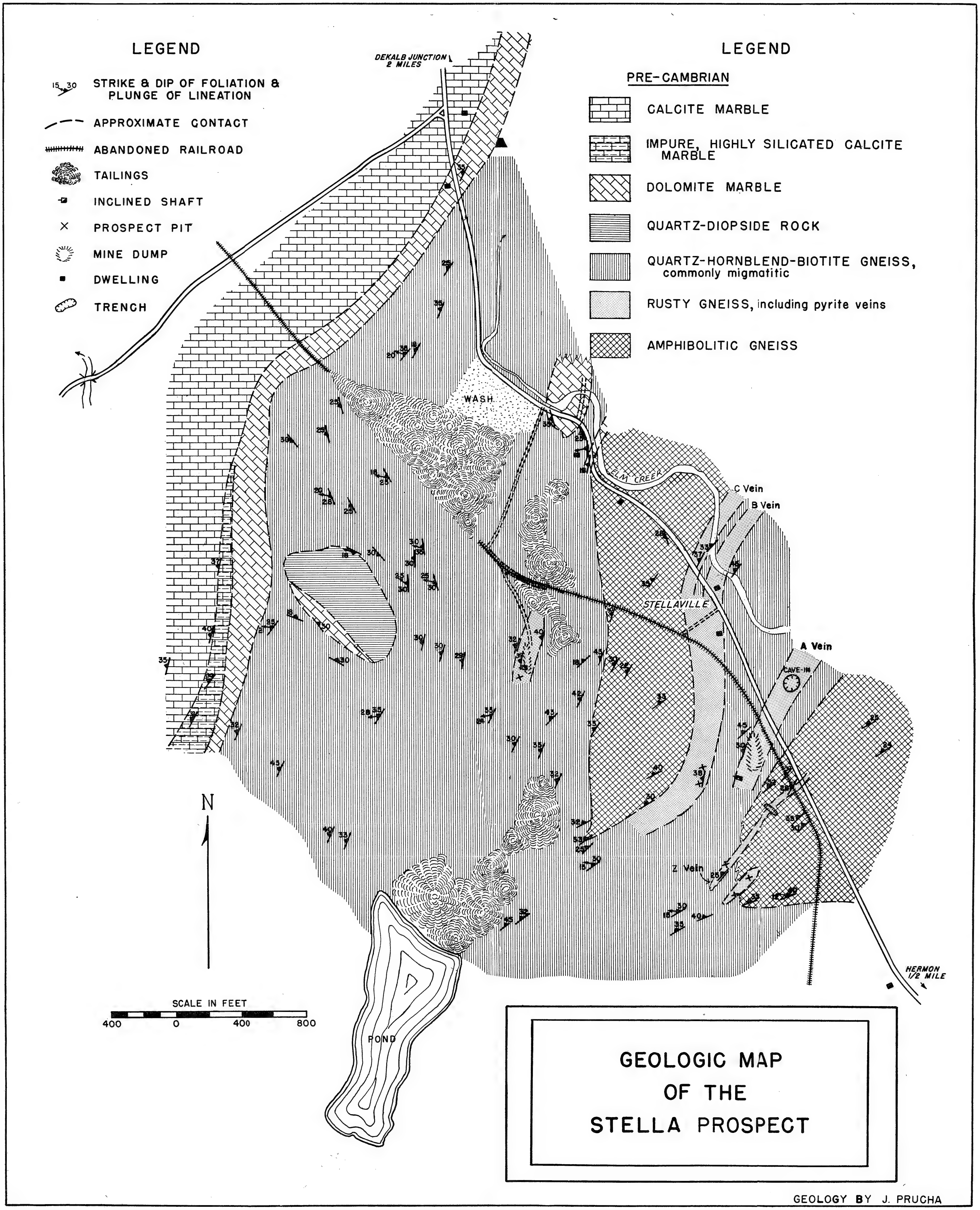
SCALE IN FEET

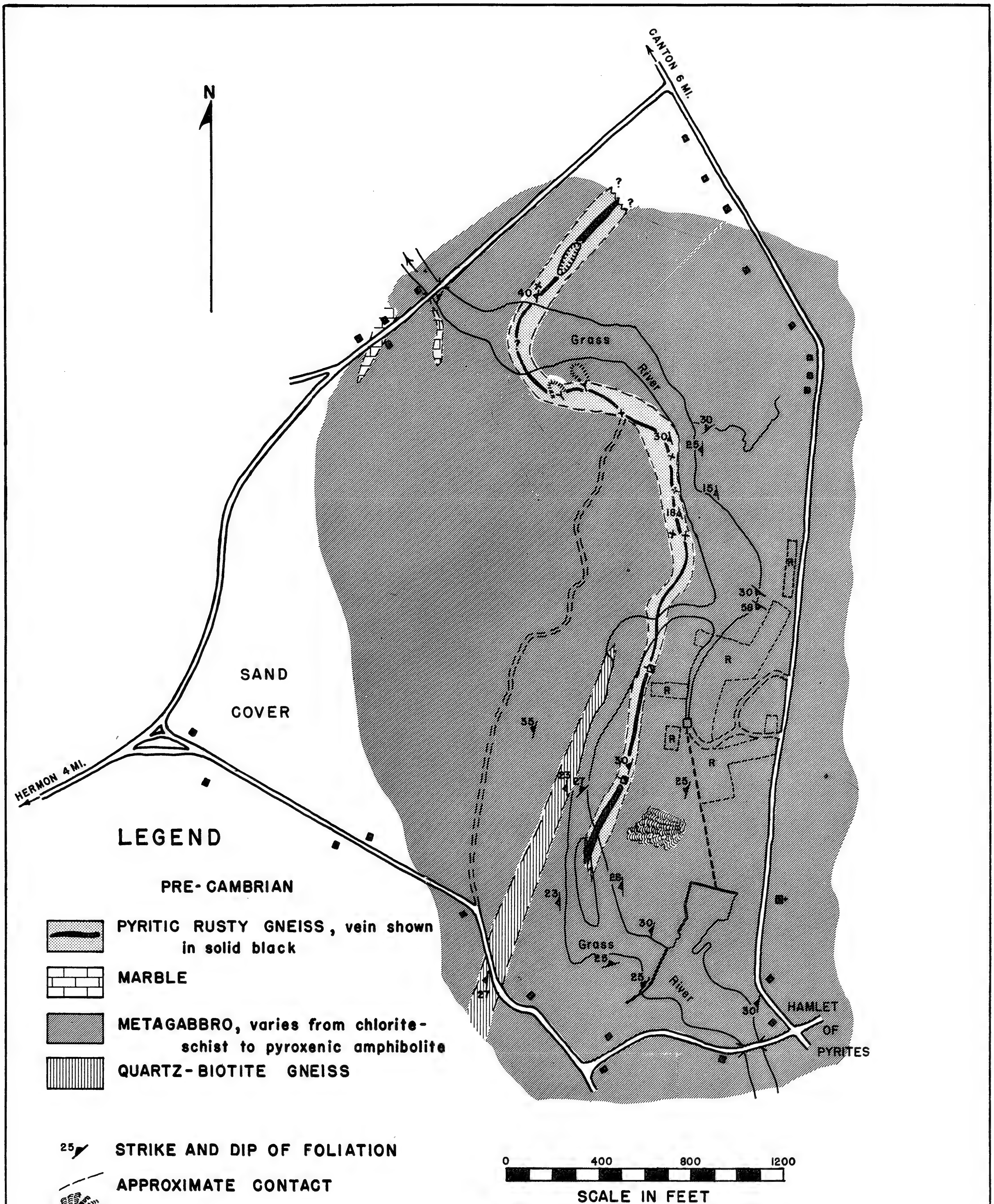
GEOLOGIC MAP OF THE GOLD HILL PROSPECT

GEOLOGY BY J. PRUCHA & N. CUPPELS 1951


DEKALB FELDSPAR MINE 1 MILE
BIGELOW 1.5 mi.
Indian Creek
STILES
MITCHELL
FARR
MOSS RIDGE
LEGEND
CAMBRIAN
POTSDAM SANDSTONE
PRE CAMBRIAN
AMPHIBOTITE & GARNETIFEROUS QUARTZ-BIOTITE GNEISS
THIN BEDDED QUARTZITE & SILICATED MARBLE, INTERLAMINATED
SILICATED DOLOMITE MARBLE
QUARTZ-BIOTITE GNEISS
RUSTY GNEISS, including the pyrite veins
CALCITE MARBLE
GNEISSIC GRANITE
STRIKE AND DIP OF FOLIATION AND PLUNGE OF LINEATION
APPROXIMATE CONTACT
LIMIT OF OUTCROP
MINE SHAFT
TALC PROSPECT
DWELLING
N
400 0 400 800 1200
SCALE IN FEET
GEOLOGIC MAP OF THE STILES-MITCHELL-FARR PROSPECTS
GEOLOGY BY J. PRUCHA

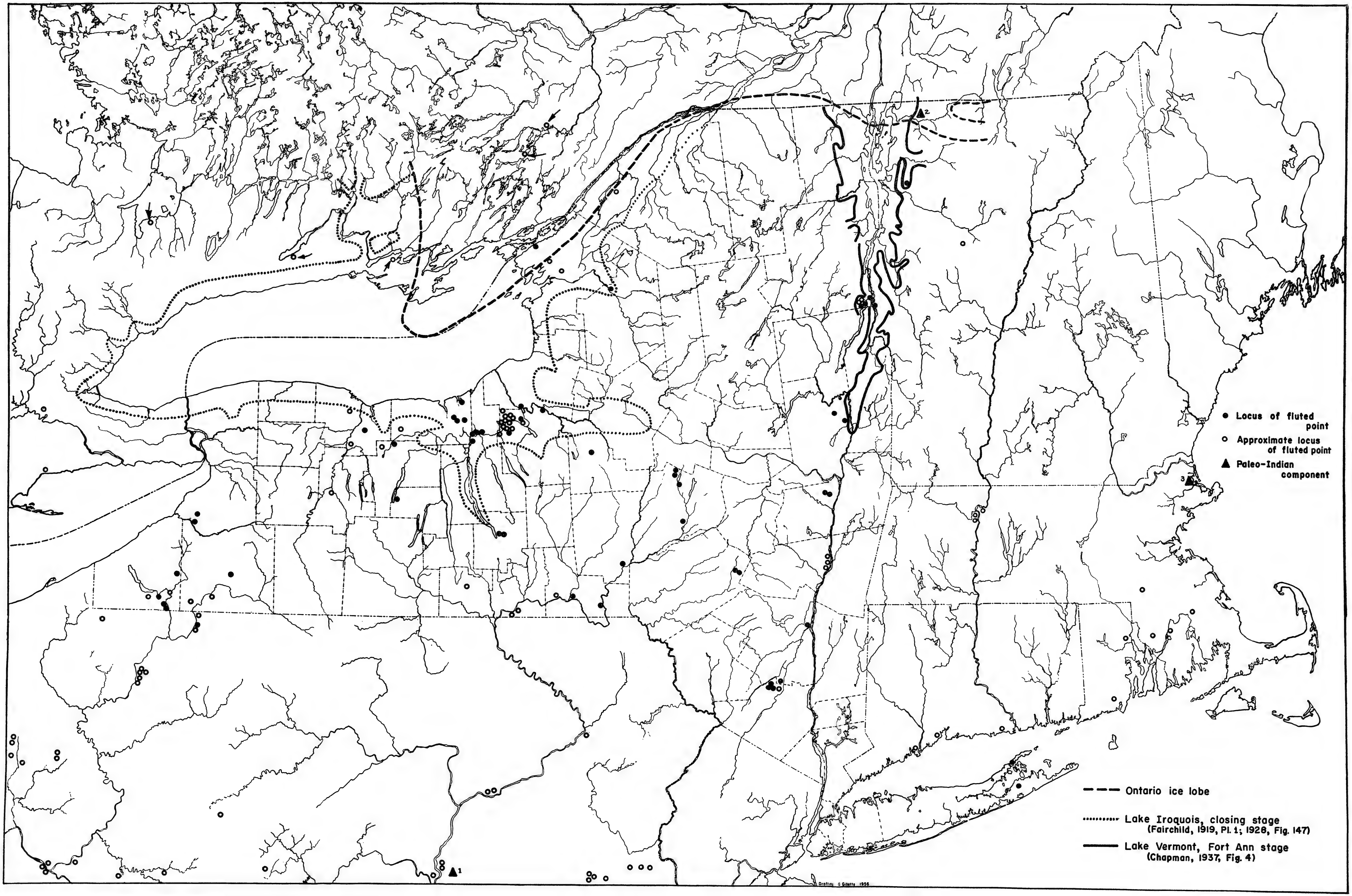

GEOLOGIC MAP OF THE DICKSON-WIGHT PROSPECTS
LEGEND
CAMBRIAN
POTSDAM SANDSTONE
PRE-CAMBRIAN
MARBLE
RUSTY GNEISS, including the pyrite veins
HEMATITIC QUARTZ-CHLORITE SCHIST
GARNET-PYROXENE GNEISS
GNEISSIC GRANITE and PEGMATITE
STRIKE AND DIP OF SEDIMENTARY BEDS
STRIKE AND DIP OF FOLIATION
APPROXIMATE CONTACT
LIMIT OF OUTCROP
ABANDONED RAILROAD SPUR
INCLINED MINE SHAFT
OPEN MINE PIT
PROSPECT PIT
MINE DUMP
DWELLING
N
GOUVERNEUR 11 mi.
ANTWERP 1.4 mi.
400 0 400 800 1200
SCALE IN FEET
GEOLOGY BY J. PRUCHA


LEGEND
STRIKE & DIP OF FOLIATION & PLUNGE OF LINEATION
APPROXIMATE CONTACT
ABANDONED RAILROAD
TAILINGS
INCLINED SHAFT
PROSPECT PIT
MINE DUMP
DWELLING
TRENCH
LEGEND
PRE-CAMBRIAN
CALCITE MARBLE
IMPURE, HIGHLY SILICATED CALCITE MARBLE
DOLOMITE MARBLE
QUARTZ-DIOPSIDE ROCK
QUARTZ-HORNBLEND-BIOTITE GNEISS, commonly migmatitic
RUSTY GNEISS, including pyrite veins
AMPHIBOLITIC GNEISS
DEKALB JUNCTION 2 MILES
WASH
ELM CREEK
C Vein
B Vein
STELLAVILLE
A Vein
CAVE-IN
Z Vein
HERMON 1/2 MILE
N
SCALE IN FEET
400 0 400 800
POND
GEOLOGIC MAP OF THE STELLA PROSPECT
GEOLOGY BY J. PRUCHA

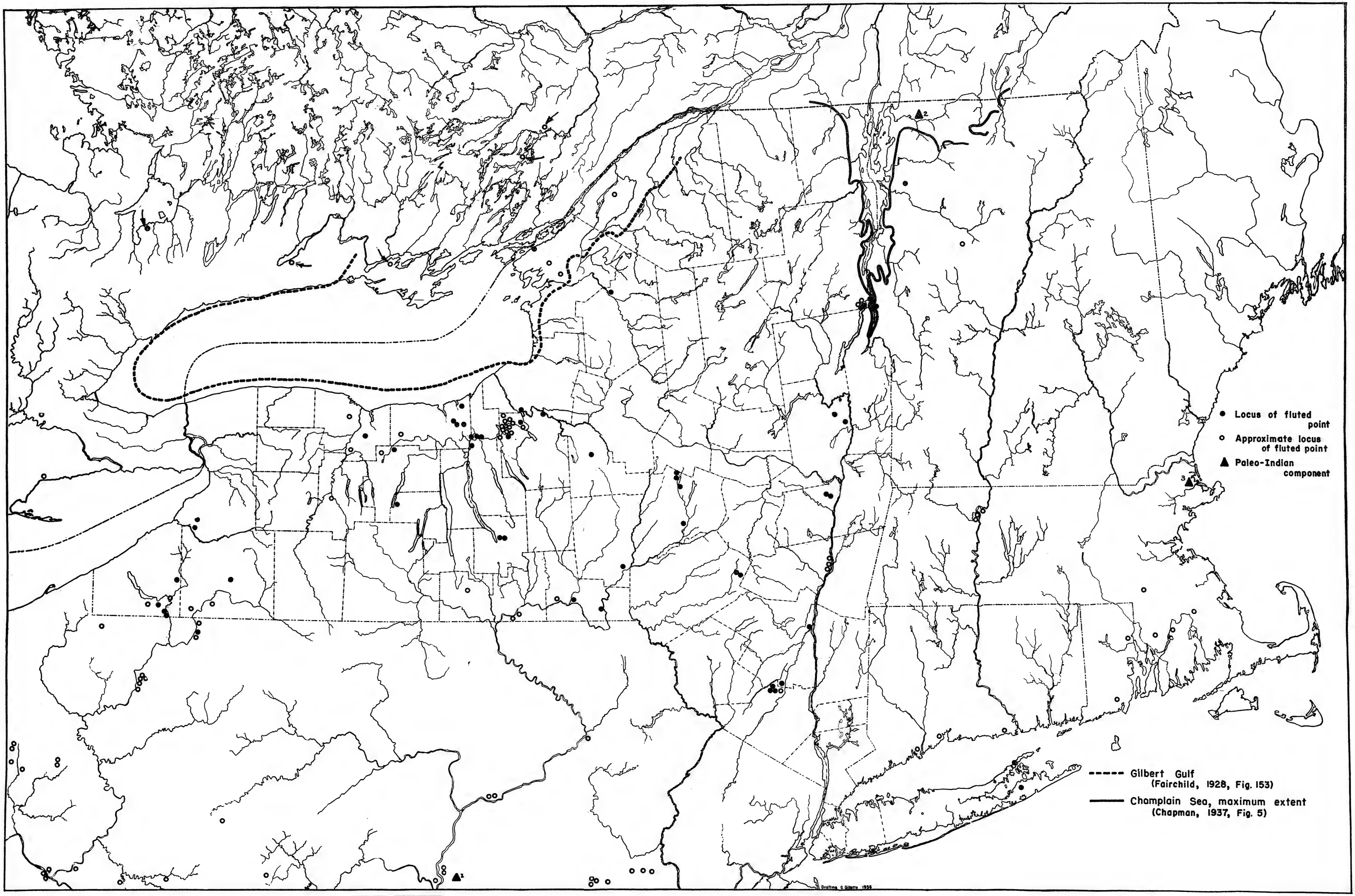


GEOLOGIC MAP OF THE PYRITES PROSPECT

GEOLOGY BY J. PRUCHA 1952



Locus of fluted point
Approximate locus of fluted point
Paleo-Indian component
Ontario ice lobe
Lake Iroquois, closing stage (Fairchild, 1919, Pl. 1; 1928, Fig. 147)
Lake Vermont, Fort Ann stage (Chapman, 1937, Fig. 4)
Drafting G Gillette 1956



Locus of fluted point
Approximate locus of fluted point
Paleo-Indian component
Gilbert Gulf (Fairchild, 1928, Fig. 153)
Champlain Sea, maximum extent (Chapman, 1937, Fig. 5)
1
2
3
Drafting G Gillette 1956

UNIVERSITY OF THE STATE OF NEW YORK
NEW YORK STATE MUSEUM AND SCIENCE SERVICE
ALBANY, NEW YORK

W.N. FENTON, ASSISTANT COMMISSIONER
JOHN G. BROUGHTON, STATE GEOLOGIST

STRATIGRAPHIC SECTIONS
SHOWING
SALT ZONE & OTHER KEY HORIZONS

COMPILED BY
W.L. KREIDLER, SENIOR GEOLOGIST

Horizontal scale
10 0 10 20 30 40
miles

PLATE II